The present invention relates to underjet coke ovens and more especially to underjet coke-oven batteries having basements therebelow including passageways accessible to the operators wherefrom there can be made regulatory adjustments in the distribution systems for the gaseous media flowed into and from the coke-ovens' heating flues, and the like; the invention is particularly concerned with coke-oven batteries of the stated type wherein the atmosphere of said basement passageways is free to circulate over the pipes and gas-flow regulatory means of combustion-media distribution systems of said underjet batteries.

An object of the present invention is the provision of improved means for continuously displacing the atmosphere of the basement passageways of an underjet coke-oven battery so that there can be maintained in said passageways lower temperatures than would otherwise obtain and thereby providing more comfortable working conditions for the battery operators.

A further object of the present improvement is the provision of means whereby the above-stated object can be realized while at the same time maintaining a substantially uniform temperature, along the entire lengths of those afore-said combustion-media distribution pipes, and at their associated regulatory means for apportioning said media to the individual heating flues of said coke-oven batteries.

A further object of invention is the provision of improvements whereby the above-stated objects can be realized without limiting the efficiency of the battery-stack to carry battery combustion-products into the outside atmosphere and whereby the atmosphere of corresponding portions of the battery basement can be maintained at a substantially uniform static pressure more especially in those instances where features of the invention are employed in underjet batteries designed to take their combustion air from their basement passageways.

A further object of invention is to furnish such improvements in combustion-media and combustion-products flow-boxes for the regenerators as especially adapt them for the present purpose, and the realization of the above-stated objects.

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 of apparatus hereinafter described or claimed.

The above-stated objects of invention are realized according to the present improvement by supplying underjet coke-oven batteries with a plurality of air-inlet openings that are disposed longitudinally of the basement thereof and communically connect the same with a source of outside air and, transversely of said battery-basement from said air-inlet openings, there is also disposed a plurality of air-voiding openings that also lead from said basement to the atmosphere, the said air-inlet and air-voiding openings being preferably located at a battery-level beneath the level of those combustion-media distribution pipes for supplying fuel-gas to the individual heating walls in those installations where the basement atmosphere is free to circulate over such pipes.

According to the preferred embodiment of the present improvement, the aforesaid air-inlet openings communicate with a source or reservoir of air that is deliverable to said openings at slightly above atmospheric pressure. The air-voiding openings of the coke-oven battery-basement in that embodiment of the invention shown in detail in the accompanying drawings are communically connected with the outside atmosphere by means including an air-space that has as one surface the masonry of the battery-face itself and as its opposite surface a barrier-wall that is spaced from said battery-face and extends longitudinally thereof in the usual operating alleyway of the battery and encloses both the regenerator flow-boxes and the lower portions of the battery buckstays, the top of said air-space being preferably formed by a plurality of short horizontally-extending walls that are located each beneath the level of a coking-chamber sole with their one side in contact with the battery-face and their opposite side integral with the aforementioned barrier-wall and their ends terminating at the edges of the flanges of adjacent buckstays, thereby providing at the upper part of that said enclosed air-space and adjacent the opposite sides of the web of each I-shaped buckstay a pair of openings therefor to the atmosphere. According to the invention, the so-formed openings of each said pair thereof are each individually furnished with a small stack-like duct that extends to the upper part of one side of a buckstay and is formed by spotwelding a metallic strip to adjacent edges of the buckstay flanges. By means of such arrangement, air being displaced from the battery-basement flows first through the air-voiding openings that are located beneath the rich fuel-gas distribution pipes, thence over the hot regenerator flow-boxes thereby increasing its buoyancy and...
its tendency to rise and pass into the atmosphere through the small stack-like ducts that are formed in part by a portion of the buckstays.

The invention also provides novel regenerator flow-boxes that are especially suitable for use for the present purpose; their valve means for flowing both combustion-air and combustion-products respectively into and from the regenerator sole-channels are located below the battery-supporting mat and are actuated entirely from the battery-basement thereby making it practical completely to isolate such flow-boxes from the alloyways in accordance with one of the features of the present improvement as will be more clearly understood by reference to the accompanying drawings and the following description of the invention.

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

Fig. 1 is a composite vertical section taken crosswise of an underjet coke-oven battery of the well-known Becker type provided with features of improvement for displacing the air of its present passageways in accordance with principles of the present invention, the section A—A being through a coking chamber whereas the section B—B is taken through a heating wall thereadjaacent, and both said sections being taken through one of the narrow air-regenerators 25 (Fig. 5) that is beneath both the coking chamber and the heating wall of said sections; Fig. 2 is a horizontal section taken along the line II—II of the battery of Fig. 1, with parts broken away.

Fig. 3 is an elevational view partially in section taken on line III—III of Fig. 4; Fig. 4 is an enlarged view of a portion of Fig. 1; Fig. 5 is an enlarged view similar to that shown in Fig. 3 but with the lean fuel-gas main removed and showing the disposition of a series of the novel regenerator flow-boxes used for the present purpose; Fig. 6 is an enlarged vertical section taken through an air-inlet of an improved regenerator flow-box of invention; and Fig. 7 is an enlarged plan view showing details of the valve-actuating mechanism for the regenerator flow-boxes.

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

The underjet coke-oven battery illustrated in the drawings comprises the well-known underjet type of Becker coke oven and embodies many of its characterizing features which do not require particularly detailed description for the present purpose because the advantages of the present improvement are realizable in combination with underjet coke-oven batteries of a variety of constructional features and are not dependent solely upon any special characterizing features of oven design. The coking chambers 10 of the illustrated battery alternate longitudinally of the battery walls 11 therefor, said heating walls being supplied with verticallydisposed heating flues 12 that are communically connected groupwise with corresponding heating flues in an adjacent heating wall by means of cross-over duct 13 that extends over the intermediate coking chamber in the well-known manner. The opposite ends of coking chamber 10 are each sealed by a removable door 14 and the masonry of each heating wall II is supported in its designed location by a buckstay 15 at each end thereof, each such buckstay being formed of a rugged I-beam that is affixed at its lower end to those metallic beams 16 that form the complete of the usual battery-supporting mat 17. The upper end of each buckstay 15 is tied to the upper end of a similar buckstay at the opposite end of each heating wall by a boited tie-rod 18 that extends across the top of the battery.

Beneath the coking chambers and their adjacent flued heating walls are the coke-oven regenerators and their associated sole-channels, each heating flue of a heating wall being communically connected individually at its lower part by short duct means with the upper part of a wide regenerator 19 (Fig. 5) that is communically connectable by means of one or a pair of sole-channels 20 with a regenerator flow-box 21 (Fig. 5) of invention whereby the said regenerator 19 can be optionally supplied intermittently with either combustion-air from the battery-basement 22 or, in combination-oven operation, with lean fuel-gas, such as blast-furnace or producer gas, drawn from lean-gas main 23 that is supported on top of wa. The said regenerator flow-boxes 21 are also arranged in alternation to admit a combustion-medium, aforesaid, into a regenerator 19 or to flow its combustion-products into the waste-heat duct 24 whence they pass to the usual stack means for the battery (not shown). Each heating flue of a said heating wall is also communically connected at its lower part by short duct means with the upper part of a narrow regenerator 25 (Fig. 5), that is co-extensive with a said wide regenerator 19, and is also supplied with its individual sole-channel 20 the outer end of which communicates with a regenerator flow-box 26 (Fig. 5) of invention that is disposed in alternation to admit combustion-air from the battery-basement into a said regenerator 25 and to flow combustion-products into said waste-heat duct 24.

At such times as the illustrated battery is operated as a "cove-oven" and the heating flues are heated with non-regeneratively-preheated rich fuel gas, such gas is introduced into the lower ends of the heating flues in individually proportioned amounts through underjet ducts 27 that are individual to each heating flue and are disposed in those regenerator division walls 28 that are each directly beneath a heating wall 11. The said rich heating gas is supplied to the heating flues from the primary fuel-gas mains 29 that communicate by a valve means 30 with each wall-header pipe 31 that extends crosswise of the illustrated battery in substantial parallelism with its heating wall thereon, each said pipe 31 communically connected with all the heating flues of its corresponding heating wall wall and with appropriate piping-connections 32 that join at their upper ends with the lower ends of the masonry ducts 27. In each of said piping-connections is disposed a replaceable gas-flow regulator means (not shown) whereby the quantity of rich fuel-gas distributed to the latter individual heating flues can be apportioned in accordance with its position in its heating wall.

The masonry of the illustrated battery is supported as aforementioned on a concrete mat 17 which in turn is directly supported by a multiplicity of longitudinally-extending I-beams 16 and heavier transversely extending I-beams 33.

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the latter each resting on the tops of several aligned piers 34 whereby the whole battery structure is suspended sufficiently above the passageways of the battery-basement 22 to permit convenient access of all parts thereof to the operators.

The aforementioned lean-gas main 23, waste-heat duct 24, and regenerator flow-boxes 21, 26, for the whole battery are located at only one side thereof at a level lower than the platform 35 of the pusher-side and which is provided with the supporting-pliers forms the usual alleyway 38 that extends along the face of the coke-oven battery. Combustion-media and their combustion-products are flowed, during the battery's heating into and from the regenerators at the pusher-side of the battery and the coke-side alleyway 38 for the battery has no regenerator flow-boxes. The alleyways 35, 38, are each entirely enclosed by end walls and a side-wall, the latter having disposed thereof along spaced intervals of access-ports 37 for regulating access of outside air to said alleyways. The said alleyways are interconnected at both ends by similar enclosed crosswise alleyways that extend transversely of the battery beyond the piers 34 supporting the battery-masonry at its opposite ends whereby providing an enclosed alleyway that is continuous around the entire battery. Doors at opposite ends of the pusher-side alleyway 38 give the operators access thereto from outside the battery.

At the battery-basement level the battery pinion walls 39 are penetrated by passageways 40, which by means of air-tight doors 41 at either end thereof, serve as “air-locks,” whereby enabling operators to enter the basement passageways at their level without substantial loss or ingress of air therethrough.

The regenerator flow-boxes 21, 26, are structurally supported in the masonry and concrete of the upper part of the walls of waste-heat duct 24. They have an essentially L-shaped profile, the vertically-disposed leg being bifurcated at its lower end into branches 42, 43, the former of which communicates with said waste-heat duct and has pivotally mounted in its walls damper valve 44 that is arranged for manual rotation from the battery-basement by crank-handle 45 to adjust the available-free-way of said branch 42 whereas the flow-box branch 43 extends into the space of the battery-basement and is arranged to receive battery-heating combustion-air from said basement. The horizontally disposed leg of said flow-boxes communicates with a regenerator sole-channel 28. The aforesaid branches 42, 43, of the flow-boxes are each provided at the same level below the battery main with a valve, respectively 46, 47, the former controlling the passageway of that branch leading to the waste-heat duct and the latter similarly controlling the opening whereby branch 43 receives combustion-air from the battery-basement. The said valves 46, 47, are mounted on separate shafts 48, 49a, and these shafts are so interconnected by a lever-system that their associated valves are rotatable simultaneously in alternation into opened and closed position in respect of their respective passageways 42, 43, by means of the usual reversing machine for the battery (not shown) operating through lever 45 and its associated reversing rod 49b.

Those regenerator flow-boxes 21, as clearly shown in Fig. 5, that are associated with the large regenerators 19 are provided with means for flowing either lean gas or combustion air thereinto. For the former purposes, they are each communicably connected with a pipe 50 through which lean gas from main 33 therefore can be flowed into said regenerators. The lean-gas valve in pipe 50 can be moved into either opened or closed position by appropriate movement of cable 51 of the gas-flow reversing machine for the battery operating through valve-handle 52. By means of a clutch connection that is auxiliary to the lever-system for actuating valves 46, 47, of the flow-boxes 21, a shaft 48a thereof is easily disconnectable from actuation by said lever-system, so that when lean gas instead of combustion-air is introduced into their regenerators, air valves 47 are assured of being in sealed position in the battery-basement and they can be locked in this sealed position by a thumb-screw 49a that is disposed upon rotation to engage the body of a closed valve and hold it against its valve seat. Thumb-screw 49a is rotatably supported in one of the finger-bars 50a that serve to adjust the effective free-way of the air-inlet to said flow-boxes.

According to that embodiment of the instant improvement shown in drawings, the reservoir for delivering air to the hereinafter discussed air-inlet openings to the battery-basement 22 is formed as a large conduit or channel 53, that extends along the full length of the coke-side of the battery and occupies a major portion of the space directly beneath the coke-side alleyway 38 and is formed by spaced outer and inner concrete walls, respectively 54, 55, the latter said wall also functioning as one of the side-walls of the enclosed battery-basement. A short wall 56 seals one end of the conduit 53 and at its opposite end, as clearly shown by reference to Fig. 2, said conduit increases somewhat in width and at its point of entry into the enclosed enclosure 57 its axis bends slightly toward the battery structure. A similar but shorter conduit 58 extends along the adjacent pinion-wall 39 of the battery and communicates with said enclosed enclosure 57 at approximately a right angle to the aforesaid conduit 53, both said conduits 53, 58, and the enclosure 57 being at substantially the same horizontal level. At its end adjacent alleyway 36 at the pusher-side of the battery, short conduit 58 is communicably connectible, by means of a louvered opening 59 in its end wall 60, with the space of alleyway 36 thereabove, for purposes hereinafter more fully described.

Louvered openings 61, 62, in the outside walls of the enclosed enclosure 57 make it possible to draw air into said enclosure from the outside atmosphere by power means in the form of fan 63 that is driven by electric motor 64 operating through driving-belt 65, said fan being disposed at the open end of conduit 53 adjacent the point where its wall expands into enclosure 57. The illustrated fan is of the so-called airplane-propeller type although any other type of air-compressor means adapted to deliver air from the atmosphere into conduit 53 is of utility as the power means for the present purpose. In the drawing, motor 64 and fan 63 are disposed to draw air from the atmosphere through openings 61 or 62 and to deliver the same into conduit 53 at above atmospheric pressure. The airplane-propeller type of fan is preferred as it is a power means because of the large free-space between its blades which makes it possible without removing it from its operating position to operate by natural draft.
the present improved system for displacing air from the basement of a coke-oven battery. Below the level of fuel-gas distribution pipes 31 and at spaced intervals along wall 55 of conduit 53, basement-passageways 22 of the battery communicate with said conduit by means of air-inlet openings 56 that are provided each with louvers 67 whereby the effective free space of said openings is optionally regulable. Thus, by means of these air-inlet openings air in excess of atmospheric pressure in conduit 53 can be equally distributed at points lengthwise of the battery to the bucket-stay flanges and be caused to flow transversely thereof in a plurality of streams of substantially equal pressure and velocity.

In order that air introduced into the battery-basement through said openings 56 will not short-circuit the basement and escape into, for example, alleyway 38 thereabove through the interspace between the ends of I-beam 32 and the upper part of conduit-wall 55, flashing plates 68 are furnished the entire length of the coke-side battery face; they are attached at their upper edges to one of the horizontally-extending, battery-supporting I-beams 16 and at their lower edges are caulked into a groove formed into the top of concrete wall 55 substantially as shown in Fig. 1, thereby sealing the basement passageways 22 of alleyway 38 from said openings. The ends of the basement are sealed against leakage and short-circuiting by contact of the pinion walls with the concrete of mat 17.

At the pusher-side face of the battery, a portion of the usual space of the alleyways is sepa-
rated therefrom by a barrier wall 69 that extends the full length of the battery and forms between the remaining alleyway space and the masonry of the battery-face an interspace 70 that contains the lower portion of the buckstays and the regenerator flow-boxes 21, 26, (with the exception of those portions of the former flow-boxes for regulating the flow of lean gas to the regenerators). The barrier wall 69 may be formed of any structurally appropriate non-flammable material such as Transit stone. The sides and ends of said interspace 70 are sealed from the atmosphere whereas the bottom is open to the battery-basement, so that air can flow freely from the latter into the former. The lower edge of said barrier-wall rests in air-tight contact with the upper surface of that massive concrete forming the top of waste-heat duct 24, and its upper vertically-extending section is supported adjacent the outer flanges of the buckstays 15, by the beams that structurally support the pusher-side bench. (In Fig. 1, this upper section of said barrier wall is shown spaced a short distance from the buckstays; in the fully expanded battery, however, the barrier wall will be in contact with the buckstay flanges.) An upper extension of barrier-wall 69, above the paved surface of pusher-side bench 71, is formed by a continuous strip of Transit plate 72 that extends the entire length of the battery and is supported by the outer bucket stay flanges and at their upper edges are in contact with the vertical portions of those apron-plates 73 that extend outwardly and downwardly from the oven-soles. A small replaceable cover-plate 74 covers an opening in a plate 72 and gives access to a regenerator inspection hole 75.

The top of said interspace 70 is formed by vertically disposed strips 76 of Transit, one such strip being arranged in an almost level distance beneath each said apron-plate along the pusher-side of the battery. These strips 76 each cover an opening limited by the battery-masonry, a plate 78, and the edges of adjacent flanges of adjacent buckstays. They are supported by sections of L-irons 77 that are spot-welded to the flanges of the buckstays and their ends terminate at the edges of said buckstay flanges leaving at each end thereof a relatively small opening 78 (Fig. 3) that forms the inlet end of a buckstay-stack 79 which is itself formed by spot-welding a metal-plate 80 to those edges of buckstay-flanges at the same buckstay-side. The metal plates 80 preferably rise and are vertically aligned a buckstay 15 to a point above the top of a cooking-chamber mouth. By means of the described arrangement, currents of air flowing upwardly through interspace 70 around the regenerator flow-boxes therein and along the masonry of the regenerator faces eventually come into contact with strips 76 of Transit whereby they are deflected into buckstay-stacks 79 along which they travel upwardly until their discharge into the outside atmosphere at the top 81 of said buckstay-stacks.

The pavement 82 of alleyway 38 forms the ceiling of conduit 53 and is provided therealong with circular openings 83 that are furnished with removable plate covers 84 which can be replaced, for purposes hereinafter described, with similar covers formed of iron grills.

In consequence of the high temperatures carried in the masonry of coke ovens, heat penetrates through the battery-mat into the basement passageways of underjet coke ovens at oppressively high temperatures for the operators obtain therein unless the heated air is displaced by cooler air at a sufficiently rapid rate to remove the heat and maintain comfortable working temperatures therein. It is not adequate, however, merely to displace the heated basement atmosphere by withdrawing it into the regenerators and employing it for combustion purposes in the battery because the rate of air withdrawal is limited to combustion requirements which are insufficient to alleviate the condition and such method must be augmented by other means. If such augmentation is provided by introducing larger quantities of cooler air into the basement-passageways, through a single opening, either by means of an exhaust-fan or a blower, disadvantageous results arise, more coke-oven batteries wherein the inflowing air is free to circulate around the fuel-gas distribution headers 31, because those of said pipes that are adjacent to, or those portions thereof that are directly in, the flow-path of the total quantity of the inflowing cooler air can be unduly chilled at points adjacent the air-inlet opening. In result, the fuel gases distributed by such pipes, or portions thereof, are cooled below the condensation points of some of their more easily condensable constituents. These condensable constituents then tend to be deposited in the entrances of those gas-flow regulator means for apportioning fuel gas from said pipes 31 into underjet ducts 27 for delivery to the individual heating flues and thus to alter their calibrations, thereby disturbing any otherwise obtainable uniformity of heating along the heating walls which is necessary for maintaining their continuous policing. In addition, air flowing into and out of the battery basement, through a single inlet or outlet, sets up a swirling and eddying of the basement air into indeterminate and continuously changing flow-paths and, in consequence, air can be relatively dormant in some portions of the battery-basement and in
others be unnecessarily agitated. In those battery structures that are equipped to withdraw their combustion-air from the battery-basements the continuous fluctuation of the static pressure of the basement-atmosphere before the regenerator flow-box inlets disturbs continuous uniformity of flow of combustion-air to the heating flies and is prejudicial to continued uniformity of their heating. Furthermore, the moment that the basement air by means of a suction fan tends to maintain in said basement a pressure of air somewhat less than atmosphere, thereby reducing the efficacy of the height of an existing stack to discharge combustion-products into the atmosphere. In the preferred embodiment of the present improvement, the fan of the power means for introducing the displacing air into basements of underjet batteries is thus disposed to deliver the same at pressures in excess of atmospheric so as to increase the effectiveness of the stack. In this connection there should be mentioned the feasibility of employing with the power means, as in combination with the motor for driving said fan, actuating means that are responsive to fluctuations in the pressure of the outside atmosphere to cause the fan continuously to deliver into the battery-basement such variable quantities of air as will maintain, regardless of the pressure or the humidity of the outside atmosphere, those basement air-pressure required continuously to cause a uniform weight of air, or oxygen, to flow into the regenerators during a given time interval, thereby improving continued uniformity of heating of the battery from day to day.

In the operation of the hereinafore described coke-oven battery having its basement-passageways substantially sealed from direct communication with either the outside atmosphere or with the alleyways, louvers 50, 62, in the enlarged enclosure 57 are opened sufficiently to permit rotating fan 63 of the power means to draw, into said enclosure from the outside atmosphere, and then to deliver into air-conduit 53 at above atmospheric pressure, atmospheric air at a rate preferably about three times the rate at which air is required for purposes of combustion in the heating-flues of the battery. Flowing along said conduit 53, the delivered air is allocated spaced intervals into basement-passageways 22 through adjustable louvers 67 of the air-inlet openings 66 of said conduit 53, and the so-allocated air flows through the said basement-passageways toward the opposite battery side in side-by-side streams of substantially equal velocity and corresponding pressures by appropriate adjustment of the louvers in air-inlet openings 66, thereby displacing at a substantially uniform rate in all parts thereof the battery-heated air of the basement-passageways by cooler outside air. By reason of the location of openings 66 in respect of fuel-gas pipes 31, as well as also the downward directed louvers 67, the inflowing cooler air with its greater density tends to clink toward the bottom of the basement-passageways and flow therealong, the result being a continuous recirculation into substantial contact with or greatly cooling fuel-gas distribution pipes 31. Thus, the currents of displacing and cooling inlet-air tend, by reason of the invention to follow flow-paths along the lower level of the battery-basement where they are needed for the physical basement of the operators. In consequence of diffusion and continuing radiation from the battery mat however, the inflowing air increases somewhat in temperature as it progresses crosswise of the battery and tends to rise toward the air-voiding openings at the opposite battery side, a portion of it returning along the distribution-pipes 31 in countercurrent flow to the cooler air nearer the floor of the basement-passageways before heating and mingling with the currents of inflowing air, as shown diagrammatically by the arrows of Fig. 1. Thus, in effect, the apparatus of invention provides means whereby displacing and cooling air-strata of different temperatures can, from a single source, be flowed across the basements of underjet batteries, the stratum of lowest temperature being adjacent the basement floor where it is beneficial for the operating personnel whereas the warmest stratum circulates along and around fuel-gas pipes 31 avoiding condensation of constituents of the fuel-gas distributed by said pipes and at the same time maintaining them at relatively uniform temperature from end to end along the entire battery-basement. Having traversed the battery-basement, the warmed displacing air rises and flows into the air-voiding openings 85 adjacent the air-inlet valves 47 to the regenerator flow-boxes where about one-third of said circulated air is removed and passed into the regenerator flow-boxes and used for combustion purposes in heating the battery. The remaining two-thirds of the circulated air flows around the hot regenerator flow-boxes that are carrying hot combustion-products to waste-heat duct 24 and is thereby warmed and its buoyancy increased, thus increasing its tendency to rise through air-space 70 and thence into the diverter backstay stacks 79 whereby they are discharged into the atmosphere at a point above the tops of the coke-oven doors.

During the hottest weather, it is preferable to employ outside air exclusively as the source of air for the described purpose. However, in mild or cold weather, it is expedient and desirable to employ either a mixture of outside air with air that has been somewhat warmed in the alleyways, or to employ air derived solely from said alleyways. Any preferred proportion of the air introduced into conduit 53 can be derived from these two sources by appropriate adjustment of the effective free space between louvers 51, 62, whereby enlarged enclosure 57 communicates with the outside atmosphere, and also of the louvers 55, 66, whereby respectively the pusher-side and coke-side alleyways are communicably connectable with that shorter conduit 58 that itself ports into enclosure 57 upstream of fan 63.

By means of the described apparatus of invention, beneficial results in battery-basement cooling can also be enjoyed without employment of a fan or other air compressor power means. For example, the stack by thermo-syphon effect estableishable in the system, by heating the air in air-space 70 by radiation and convection from the hot regenerator flow-boxes, is employable alone to induce air to flow either from the atmosphere, or from alleyway 50 by replacing solid covers 84 of circular openings 83 with cribs or covers, into conduit 53 and be distributed through the basement without augmentation by power-driven means.

Manifestly in this last-described method of operation the above-discussed benefits obtained by employing air in excess of atmospheric pressure are not realizable.

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

I claim:

1. In an underjet coke-oven battery having a basement therebeneath providing accessible operating passageways, improved means for displacing the atmosphere thereof and thereby regulating the temperature of said basement, said means comprising: a plurality of air-inlet openings disposed lengthwise of said basement; spaced from said air-inlet openings transversely of said basement passageways a plurality of air-voiding means communicably connecting said passageways with the outside atmosphere and comprising duct means the upper portion of which communicates with the outside atmosphere and the lower portion of which communicates with an air-space that itself communicates with said accessible basement passageways and is intermediate a regenerator face-wall and an alleyway of said battery, said air-space including a combustion-media flow-box arranged for flowing hot combustion-products from coke-oven heating flues to the battery stack-flue whereby to heat the air in said air-space and enhance the stack-effect of said air issuing from said air-avoiding means.

2. In an underjet coke-oven battery as claimed in claim 1, in combination, a valved flow-box for flowing combustion-media and so combustion-products respectively into and from the regenerator face-end of a regenerator sole-channel, the valve means for controlling the flows of combustion-air and combustion-products respectively into and from said sole-channel being located below the battery-supporting mat with the air-intake being arranged to take combustion-air for the battery-underfiring from accessible passageways of the battery-basement.

3. In an underjet coke-oven battery as claimed in claim 2, in combination, a valved flow-box for flowing combustion-media and also combustion-products respectively into and from the regenerator-face end of a regenerator sole-channel, the valve means for controlling the flows of combustion-air and combustion-products respectively into and from said sole-channel being located below the battery-supporting mat and being arranged for their opening and closing in alternation by actuating means disposed in accessible passageways of the battery-basement.

4. In an underjet coke-oven battery having flow-boxes for flowing hot combustion-products from the outer ends of the regenerator sole-channels into a stack-flue for said battery, said flow-boxes protruding outwardly from the battery-face into the normal space of an alleyway extending therealong, a barrier wall extending along said battery-face and forming between the latter and said alleyway a restricted air-space that at its upper part is in communication with the outside atmosphere and at its lower part is in communication with the atmosphere of the battery-basement and includes the aforesaid flow-boxes, so that a flow of air passing through the so-formed air-space from the battery-basement to the outside atmosphere can be heated by the hot said flow-boxes and heat radicated from the regenerator faces to increase its stack-effect and facilitate its displacement from the battery-basement.

5. In a method of displacing the atmosphere of accessible passageways in the basement of an underjet coke-oven battery and thereby regulating the temperature of said basement passageways, the improvement comprising, heating by radiation and convection of heat from hot combustion-products being conveyed through a flow-box from the flue-system of said battery to a stack-flue, a relatively restricted column of air that is at the battery face and is continuous both with the outside atmosphere and with atmosphere of said battery-basement, thereby to increase the buoyancy of said air column and facilitate the flowing of outside air into said battery-basement.

6. In a method as claimed in claim 5, directing the column of air of increased buoyancy in a flow-path confined adjacent to a buckstay between the ends of said coke chamber of the battery upwardly to an upper portion of the battery above the tops of the coking chambers before discharging such air into the outside atmosphere.

7. In an underjet coke-oven battery having a basement therebeneath providing accessible operating passageways and also having within the atmosphere of the upper portion of said passageways fuel-gas distribution pipes for delivering heating gas to the heating walls of said battery, improved means for displacing the atmosphere of said battery-basement passageways and thereby regulating the temperature of said basement and maintaining the temperature of said fuel-gas distribution pipes substantially uniform along their entire lengths, said means comprising, in combination: disposed longitudinally of said battery basement, a plurality of air-inlet openings communicably connecting the atmosphere and said basement; transversely of said battery basement from said air-inlet openings, a plurality of air-voiding openings also communicably connecting the atmosphere with that of said basement, and power means adapted to circulate air between the air inlet and the air-voiding openings of the battery basement at a rate in excess of that rate at which air is removable from said basement by combustion requirements for the battery-heating.

8. A process for operating an underfired coke oven battery having a basement space disposed beneath the regenerators and running substantially the full length of the battery and extending throughout substantially the full width of the battery, which process comprises: introducing combustion air at spaced points along the length of the battery into the basement space from a single column of air flowing lengthwise of, but solely on one side of the battery, and under superatmospheric pressure, in an amount substantially in excess of combustion requirements and thereby introducing substantially all of the air required to support combustion of the gas burned in the heating walls of said battery and flowing the air thus introduced across the full width of the basement space thereby preheating the air and cooling the basement space, then introducing so preheated air into the regenerators and thence into the flues where it supports combustion of the gas fed to said flues and venting to the atmosphere any air in excess of combustion requirements, and flowing the resultant products of combustion through the regenerators and then through stack means for the entire battery comprising a single waste heat flue solely on the opposite side of the battery from that at which the air is introduced into the basement space.

9. In an underfired coke oven battery, the combination with a coke oven structure having coking chambers, heating flues for heating the same and regenerators communicating with said
heating flues, of a sub-structure supporting said oven structure and forming a basement space underlying substantially the entire coke oven structure, a single chimney flue disposed along the full length of the battery along one side thereof and communicating with the regenerators through flow boxes therefor, and air duct disposed the full length of the battery along the opposite side wall thereof contiguous to the basement space and separated from the basement space by a wall, the said wall having openings connecting the air duct with the basement space, connections between said basement space and the regenerators on the side of the battery at which the said single chimney flue is located whereby air introduced through said openings passes completely across the basement space through said connections and flows into the regenerators, and air-voiding means communically connecting said basement space directly with the outside atmosphere and comprising duct means the upper portion of which communicates with the outside atmosphere and the lower portion of which communicates with an air-space that itself communicates with said basement space and is intermediate a regenerator face-wall and an alleyway said battery on the side of the battery at which the single chimney flue is located, said air-space including the aforesaid flow-box connections through which the single chimney flue communicates with the regenerators for flow of hot combustion-products of the coke-oven heating flues from the regenerators to the single chimney flue whereby to heat the air in said air-space and enhance the stack-effect of said air issuing from said air-voiding means.

10. A process for operating an underfired coke oven battery having a basement space disposed beneath the regenerators running substantially the full length of the battery and extending throughout substantially the full width of the battery, which process comprises introducing controlled volumes of outside air at spaced points along the length of the battery into the basement space through one side wall of the battery thereby introducing substantially all of the air required to support combustion of the gas burned in the heating walls of said battery and flowing the air thus introduced across the full width of the basement space thereby preheating the air and cooling the basement space, introducing the preheated air into the regenerators and thence into the flues where it supports combustion of the gas fed to said flues and flowing the resultant products of combustion through the regenerators and then through a waste heat flue on the opposite side of the battery from that at which the air is introduced into the basement space, and heating by radiation and convection of heat from hot combustion-products being conveyed from the regenerators of said battery to the waste heat flue, a relatively restricted column of air that is at the battery face on the side of the battery at which the products of combustion flow off through the waste heat flue and that is continuous both with the outside atmosphere and with the atmosphere of said battery basement, thereby to increase the buoyancy of said air column and facilitate the aforesaid introduction and flow of outside air into and across said battery basement.

11. In an underfired coke oven battery, the combination of a coke oven structure having alternate coking chambers and heating walls disposed in side by side relation, each heating wall having heating flues for heating the coking chambers, and regenerators communicating with said heating flues, of a sub-structure supporting said oven structure and forming a basement space underlying substantially the entire coke oven structure, a single chimney flue disposed along the full length of the battery along one side thereof and communicating with the regenerators through flow-box connections therefor, an air channel disposed the full length of the battery along the opposite side wall thereof contiguous to the basement space and separated from the basement space by a wall, the said wall having a plurality of spaced openings along the length thereof connecting the air channel with the basement space, the top and outer side wall of said air channel throughout substantially the full length thereof being imperforate, said air channel having an air inlet at least one end thereof, connections between said basement space and the regenerators on the side of the battery at which the said single chimney flue is located whereby air introduced through said openings passes completely across the basement space and flows through said connections into the regenerators, an alleyway extending along the side of the battery above the single chimney flue, a barrier wall extending along the alleyway on the chimney side and forming between the latter and said alleyway above the single chimney flue a restricted air-space that at its upper part is in communication with the outside atmosphere and at its lower part is in communication with the atmosphere of the battery-basement and includes the aforesaid flow box connections through which the single chimney flue communicates with the regenerators, so that a flow of air passing through the so-formed air-space from the battery-basement to the outside atmosphere can be heated by the hot said flow-box connections and heat radiated from the regenerator faces, to increase its stack-effect and facilitate displacement of air from the battery-basement.

12. In a regenerative underfired coke-oven battery, a basement therebeneath providing accessible operating passageways, means for displacing the atmosphere thereof and thereby regulating the temperature of said basement passageways, said means comprising: a conduit extending longitudinally of the battery and communicably connected with said basement passageways by a plurality of openings disposed at spaced points lengthwise of said conduit; spaced from said conduit transversely of said basement passageways a plurality of air-outlet means disposed at spaced points longitudinally of the battery basement and communicably connected with said basement passageways with the outside atmosphere for volding air from the basement passageways independently of the combustion-media passageways of said coke oven battery; and air-compressor means disposed for delivering ventilating air in excess of that to support combustion into said conduit at a pressure above atmospheric pressure.

13. In a regenerative underfired coke-oven battery, a basement therebeneath providing accessible operating passageways, means for displacing the atmosphere thereof and thereby regulating the temperature of said basement passageways, said means comprising: a conduit extending longitudinally of the battery and communicably connected with said basement passageways by a plurality of openings disposed at spaced points lengthwise of said conduit; spaced from said conduit transversely of said basement pas-
sageways a plurality of regenerator air inlets disposed at spaced points longitudinally of the battery by basement for passing air from the base-
ment sageways to the regenerators of the com-
bustion media sageways and a plurality of air-outlet means disposed at spaced points longitu-
dinally of the battery and communicably con-
necting the basement sageways with the outside atmosphere for voiding air from the base-
ment independently of the combustion-media
sageways of said coke-oven battery; and air-
compressor means disposed for delivering ven-
tilating air in excess of that to support com-
bus tion into said conduit at a pressure above
atmospheric pressure.

14. In a regenerative horizontal underjet coke-
oven battery, a basement therebeneath providing accessible operating passages, means for dis-
placing the atmosphere thereof and thereby regu-
lating the temperature of said basement pas-
sageways, said means comprising: a conduit ex-
tending longitudinally of the battery and that
is communicably connected with said basement
sageways by a plurality of openings disposed
at spaced points lengthwise of said conduit;
spaced from said conduit transversely of said
basement sageways and disposed at spaced
points longitudinally of the battery a plurality of air-outlet means communicably con-\nnecting said passages with the outside at-
mosphere, said air-outlet means comprising ducts
formed adjacent the buckstays of the coke-oven
battery and extending upwardly therealong to
discharge air at a level above the level of the
tops of the coking chambers, an air chamber in-
termidate an alleyway and a regenerator face
wall on the side of the battery at which the ducts
are formed adjacent said buckstays, for confin-
ing ventilating air from flow both outwardly into
the alleyway, and upwardly in the space between
adjacent buckstays at a level below the bottoms
of the horizontal coking chambers, said air
chamber communicating with said buckstay
ducts and with said basement sageways, and
air-compressor means disposed for delivering air
in excess of that to support combustion into said
conduit at a pressure above atmospheric pressure.

15. In a regenerative horizontal underjet coke-
oven battery having a basement therebeneath
providing accessible operating passages, im-
proved means for displacing the atmosphere
thereof and thereby regulating the temperatures
of said basement passages, said means com-
prising: a conduit extending longitudinally of the
battery along one side thereof and that is com-
munically connected with said basement pas-
sageways lengthwise of said conduit; a plurality
of ventilating air outlet-means disposed longitudi-
ñually of the battery along the opposite side
thereof and communicably connecting said base-
ment with the outside atmosphere, said ventilat-
ing air outlet means comprising a ventilating air
off-flow chamber Intermediate an alleyway and
a regenerator face wall of said opposite side of the
battery and in communication at said opposite
side of the battery with said battery basement
sageways, for confining the off-flow of venti-
tilating air from flow both outwardly into the
alleyway, and upwardly in the space between ad-
jacent buckstays at a level below the bottoms
of the ends of the horizontal coking chambers,
and duct means for the discharge of air from the
air off-flow chamber to the outside atmos-
phere at a region beyond the ends of the horizon-
tal coking chambers.

16. In an underhorizontal coke-oven bat-
tery, a basement therebeneath providing acces-
sible operating passages, means for displac-
ing the atmosphere thereof and thereby regulat-
ing the temperature of said basement passage-
ways, said means comprising: a plurality of in-
dividually regulable air inlet-means disposed at
intervals lengthwise along the battery solely on
one side only thereof and communicably con-
ected with said basement passages for intro-
ducing air thereto under positive pressure;
spaced from said air inlet means transversely of
said battery a plurality of air-outlet means
communicably connecting said passages with the
outside atmosphere, said air-outlet means being
disposed solely along the side of the bat-
tery opposite that at which the regulable air in-
lets are disposed, and comprising ducts formed
adjacent the buckstays of the coke-oven battery
and adapted to confine the off-flow of air to flow
upwardly therealong from a level below the bot-
toms of said coking battery chamber and to the
region of a discharge therefrom above the tops of said chamber-doors; and
air-compressor means disposed for delivering air
into said air inlet means at a pressure above
atmospheric pressure.

17. An improved method of displacing the at-
mosphere of accessible passages in the base-
ment of a regenerative underjet coke-oven bat-
tery and thereby regulating the temperature of
said basement passages, said method com-
prising, introducing into the battery-basement
air in excess of the total volume required for un-
derfiring the battery in the form of a plurality
of flows of air at greater than atmospheric pres-
sure at spaced intervals lengthwise of the bat-
tery, directing said air-flows through the base-
ment transversely of said battery, voiding the
total volume of air required for underfiring from
the basement so as to effect the underfiring of
the battery structure therewith, and voiding air
in excess of the total quantity required for un-
derfiring the battery-structure through a plu-
arity of air-outlets at spaced intervals length-
wise along a battery-face opposite the points of
introduction of said flows of air into the base-
ment and which outlets by-pass the underfiring
system and lead from said basement directly to
the atmosphere.

18. An improved method of displacing the at-
mosphere of accessible passages in the base-
ment of a regenerative underjet coke-oven bat-
tery and thereby regulating the temperature of
said basement passages, said method com-
prising, introducing a plurality of flows of air at
greater than atmospheric pressure into the bat-
tery basement at spaced intervals lengthwise of
the battery, the volume of air of said flows there-
of being at least about three times the total vol-
ume of air required for underfiring the battery-
structure, directing said air-flows through the
basement transversely of said battery, voiding
the total volume of air required for underfiring
from the basement so as to effect the underfiring
of the battery structure therewith, and voiding
the air in excess of the total quantity required
for underfiring the battery-structure through a
plurality of air-outlets at spaced intervals along
a battery-face opposite the points of introduction
of said flows of air into the basement and which
outlets by-pass the underfiring system and lead
from said basement directly to the atmosphere.

JOSEPH VAN ACKEREN.

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Certificate of Correction

Patent No. 2,537,197

JOSEPH VAN ACKEREN

January 9, 1951

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 4, line 60, after the numeral "31" insert being; column 11, line 27, for "air-avoiding" read air-voiding; line 41, for the claim reference numeral "2" read 1;

and that the said Letters Patent should be read as corrected above, so that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 6th day of March, A. D. 1951.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.