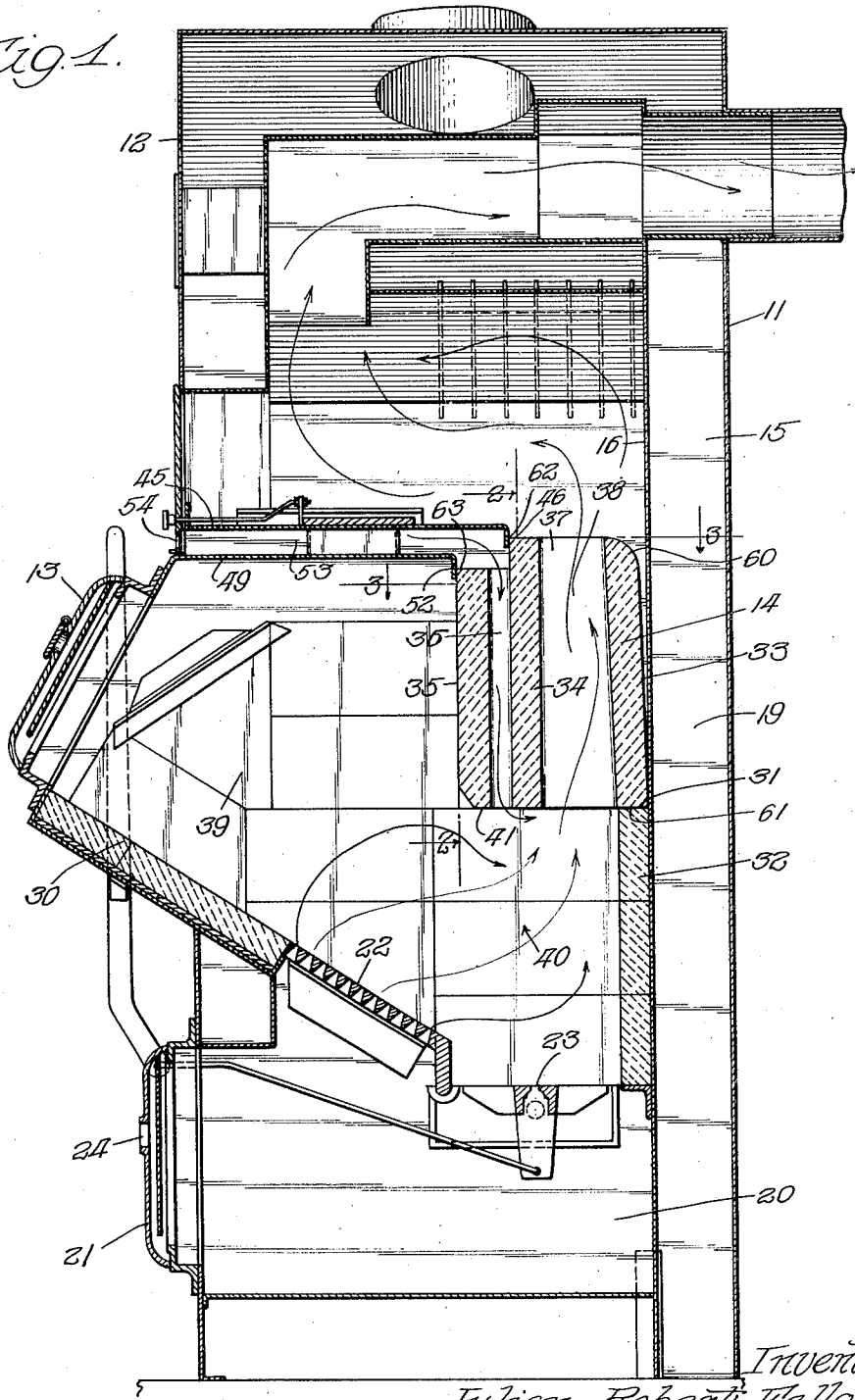
Feb. 21, 1950 J. R. FELLOWS 2,497,877

REFRACTORY ELEMENT FOR DOWNDRAFT FURNACES

Filed Oct. 7, 1944 2 Sheets-Sheet 1

Fig. 1.



Inventor:
Julian Robert Fellows,
By Britton, Wiles, Schroeder & Merriam
Attys.

Feb. 21, 1950 J. R. FELLOWS 2,497,877

REFRACTORY ELEMENT FOR DOWNDRAFT FURNACES

Filed Oct. 7, 1944 2 Sheets-Sheet 2

Fig. 2.

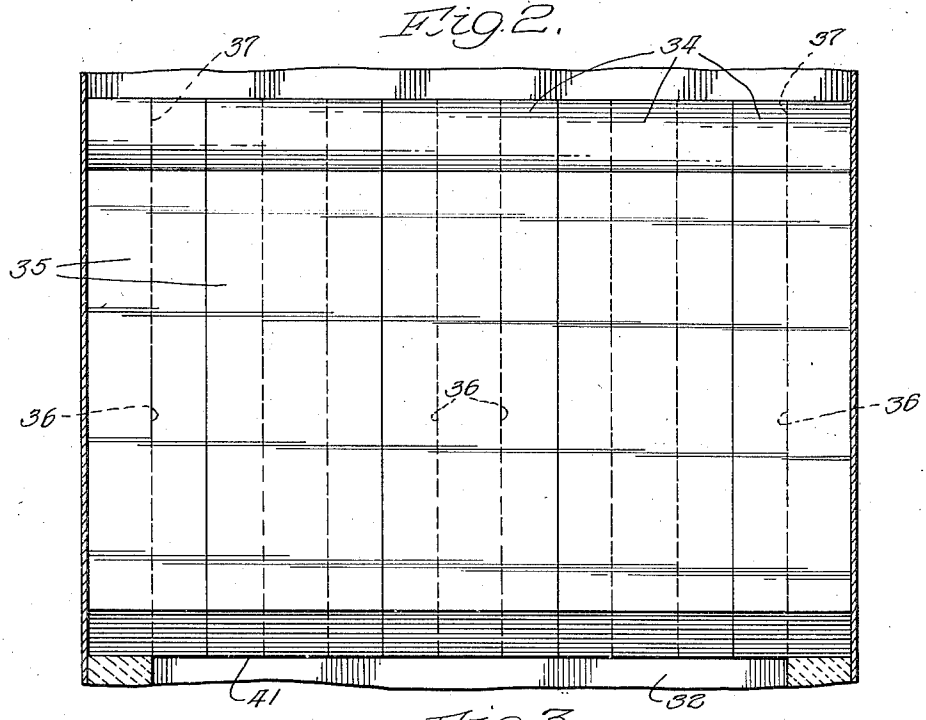
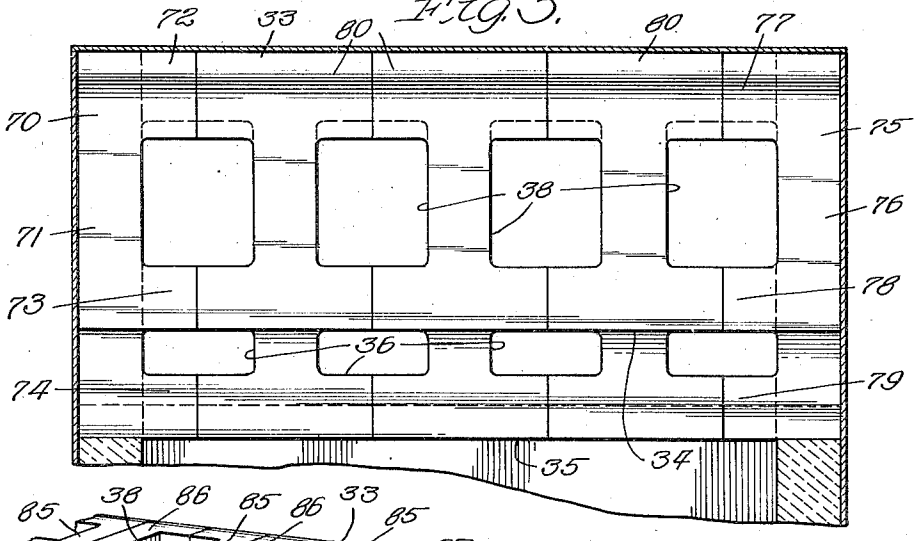


Fig. 3.



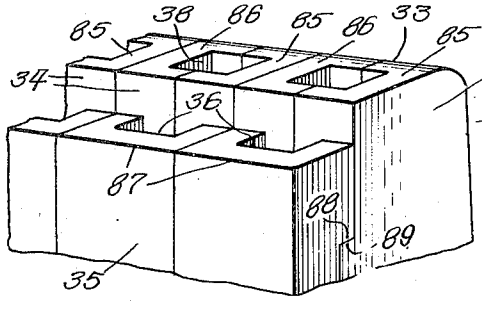


Fig. 4.

Inventor:
Julian Robert Fellows,
By Chritton, Wiley, Schroeder & Merriam
Attys.

Patented Feb. 21, 1950

2,497,877

UNITED STATES PATENT OFFICE

2,497,877

REFRACTORY ELEMENT FOR DOWNDRAFT FURNACES

Julian Robert Fellows, Urbana, Ill., assignor to The Board of Trustees of the University of Illinois, Urbana, Ill.

Application October 7, 1944, Serial No. 557,570

6 Claims. (Cl. 126—77)

1

This invention relates to a refractory element for a down-draft furnace, particularly for a furnace of the type shown in Patent No. 2,295,781, issued September 15, 1942.

Down-draft furnaces of that type are designed to burn coal and similar fuels having a high volatile content to the best advantage and without substantial smoke loss. In order to accomplish this the furnace is arranged so that its walls define a coking chamber into which the fresh or green coal is introduced and in which it is converted into coke; a coke-burning chamber through which the coke passes and in which it is burned while a fresh charge of coal is being coked in the coking chamber; and a combustion chamber in which the gases generated during coking of the coal and the burning of the coke are consumed.

In the construction shown in said patent, secondary air is introduced through a vertical baffle wall separating the coking chamber from the combustion chamber, the air emerging from the bottom of the wall on a line in the region where the coking chamber, the combustion chamber, and the coke-burning chamber come together. It has been found desirable to construct this baffle wall of a refractory material and particularly of a ceramic such as fire clay. It is also desirable from the standpoint of economy to manufacture as a unitary element the combustion chamber and the baffle so that the back wall of the combustion chamber serves as a liner for the furnace, a center wall also serves as a side of the secondary air passage and a side wall of the combustion chamber may also serve as a liner for a side of the furnace. These walls are, of course, subjected to considerable expansion and contraction stresses due to the heat of combustion, the cooling effect of the secondary air and the cooling effect of the furnace body on the walls acting as liners. For this reason breakage may occur and it is desirable that the element be readily replaceable. The present element and furnace construction are such that the entire combustion and secondary air element may be inserted or removed without any modification or adjustment of the furnace structure. This is accomplished by resting the rear wall of the element upon the lining of the furnace and resting the front wall of the baffle section and the front wall or walls of the element against fixed roof flanges in the furnace, against which they are held by gravity while pivoting on an arc of which the rear base of the element is the center of curvature. The rear wall of the element is sloped

2

from top to bottom in such manner as to clear the vertical rear wall of the furnace when the element is swung into position, while pivoted from the flanges.

The invention is illustrated in the drawings, in which Fig. 1 is a vertical sectional view of a furnace embodying the invention; Fig. 2 is a fragmentary vertical sectional view taken along the line 2—2 in Fig. 1; Fig. 3 is a plan view of a group of elements joined together to form a furnace assembly; and Fig. 4 is a perspective view illustrating the improved elements in slightly modified form.

As illustrated in the drawings, the furnace 11 includes the normal shell or casing 12 having a door 13 for the introduction of coal and a gas outlet 15 connecting with a chimney (not shown). A furnace body 16, including walls defining a firebox, is mounted within the casing in any suitable manner. The furnace illustrated provides an air space 19 between the shell 12 and the body 16. A door 21 (which may be inclined slightly inwardly and upwardly) is provided in the lower portion of the furnace communicating with the ash pit 20 and having an air opening 24.

Grates 22 and 23 are mounted within the body 16 above the ash pit. Grate 22 is a stationary grate and is disposed at an angle which may be of the order of 30–45°. The grate 23 is preferably of the shaker type.

The forward portion of the furnace below the door 13 is preferably sloped to provide a chute portion 30 which tends to slide the coal by gravity toward the grate 22.

The furnace has a double roof extending rearwardly above the firebox, and terminating in front of the rear wall, to define the gas outlet opening 15. This roof comprises an upper plate 45 having at its rear or inner end a downwardly depending flange 46. The roof also includes a lower plate 49 parallel to and slightly below plate 45. This plate terminates in a downwardly depending flange 52, a predetermined distance closer to the door 13 than the flange 46. The space between the plates 45 and 49 provides an air passageway 53 which communicates at the front of the furnace with the atmosphere through the openings 54. The passageway connects directly at the inner or rear end thereof with the secondary air passageway or channel 36 within the refractory element 14.

This refractory element which forms a combined baffle, secondary air passageway, combustion chamber and furnace liner, comprises as an element, a slightly sloping back wall 33, a

center wall 34, a front or baffle wall 35 and side walls 37. The distance between the front of wall 35 and of wall 34 is the same as the horizontal distance between the backs of flanges 46 and 52. These walls together with the remaining structure of the furnace define the combustion chamber 38, the secondary air passageway 36, a coking chamber 39 and a coke-burning chamber 40. The coking chamber, the coke-burning chamber and the combustion chamber, as well as the air inlet 36, come together in the region of the line 41 representing the front bottom edge of the refractory assembly 14.

The lower portion of the furnace around the coking, coke-burning and combustion chambers is lined with a refractory such as fire brick 32. In constructing the furnace this lining is inserted and it will be observed that on the rear wall it stops at the shoulder 31 upon which the rear walls 33 of the elements 14 rest. The sides of the furnace may be likewise constructed and the side walls 37 of the outside refractory elements 14 will rest thereon, the portion of the coking chamber above and forward of the bottom of the refractory elements 14 being preferably also lined with refractory.

The rear wall 33 of the elements is curved from the vertical. Preferably the thickness of the wall is maintained substantially constant. The front wall 35 terminates at its top substantially below the walls 34 and 33. The vertical distance between the top of the wall 35 and the top of the wall 34 is preferably about the same as the vertical height of the air passageway 53. Likewise, it is about the same as the vertical distance between the bottom edges of the flanges 52 and 46.

In inserting the refractory element 14 into the furnace the top edge of the wall 35 is placed back of the flange 52. This, of course, places the top edge of the wall 34 in a corresponding position with relationship to flange 46. The cutout portion 60 of the rear wall 33 provides clearance space so that this may be accomplished readily. The element is then lifted slightly so that the lower edge of the wall 33 will clear the lining 32, and the element is swung about a point of revolution which is substantially along the flange 46, until the bottom edge 61 of the rear wall 33 is in position above the shoulder 31. The element is then dropped into position. When this is done the front top edge 62 of the wall 34 rests against the flange 46 and the top front edge 63 of the wall 35 correspondingly rests against the flange 52. The whole structure, therefore, is supported by the shoulder 31, upon which the edge 61 rests by gravity, and by the flanges 46 and 52 against which it is swung by gravity. Of course, the side walls of the composite refractory element are also supported by the side lining of the furnace. It will be observed that the cutout portion 60 of the rear walls is sufficiently great so that the wall will not be blocked by the furnace wall 16 or the flange 46 while being swung into position. The flanges also form a tight connection for the secondary air passageway.

The description up to this point has been made in general as if the element were made in one piece. In practice the element will generally be made in at least two pieces and may be made in three or more. Certain methods of subdividing the element are described in my copending application Serial No. 486,940, filed May 14, 1943, and now Patent No. 2,433,036. These are indicated illustratively in the drawings here,

particularly Figures 3 and 4. As is there shown the element may comprise pieces of three different types. The first or left-hand element 70 comprises a long side 71 having arms 72, 73 and 74 defining an E-shaped structure, the arm 74 being considerably closer to the arm 73 than is the arm 72. The second form 75 is a mirror image of the form 70 and comprises the side 76 having arms 77, 78 and 79. The third form 80 is an integration of the forms 70 and 75 in back to back relationship. The elements are made in individual pieces to facilitate manufacture thereof and it is obvious that the forms may be modified in many ways to produce the complete assembly 14. In all cases, however, the complete element or assembly will comprise one or more combustion chambers; one or more secondary air inlets; and a baffle wall.

The elements 80 may, however, be omitted and only forms 70 and 75 employed.

The element or assembly would preferably in all cases be supported only by resting at the rear or the rear end sides of the furnace walls, and by forward pressing upon the stop means in the roof. The individual pieces of the element may be hung upon each other in any desired manner.

The partial elements are inserted individually by tilting the upper portion forwardly and inserting them until the edge 60 contacts the wall 16, and this edge is then slid upwardly until the lower edge has cleared the shoulder 31, after which the element is dropped into place with its base resting on the shoulder 31 and its walls 34 and 35 resting against flanges 52 and 46.

In the form shown in Fig. 4 the refractory elements are made up in three pieces, comprising the C-shaped section 85 and the mirror image thereof 86, and the shorter C-shaped element 87 which defines the secondary air passageway and the baffle. The section 87 is carried by gravity on the sections 85 and 86 in any suitable manner as, for example, a shoulder 88 fitting into a recess 89 in the front wall of the elements 85 and 86.

The foregoing detailed description has been given for clearness of understanding only, and no unnecessary limitations should be understood therefrom.

What I claim as new and desire to secure by Letters Patent is:

1. A refractory element for a down-draft furnace comprising a plurality of vertical walls of substantial thickness defining a pair of open-ended parallel channels, one of said channels being substantially narrower than the other and terminating at its top a predetermined distance below the other, the wall of said element most remote from the narrower channel being inclined inwardly from substantially the bottom to the top, and being rounded on the outside at the top thereof.

2. A down-draft furnace having interior walls including a bottom grate defining a firebox, a roof at the top of the firebox, an air inlet through the bottom of the firebox, a secondary air inlet in the roof of the firebox communicating with the atmosphere, a removable ceramic element disposed in the upper rear portion of the firebox and having a passageway at the front of the element open at the bottom and communicating at the top with the secondary air inlet to define a secondary air passageway and having a second passageway behind the secondary air passageway open at top and bottom to define a combustion chamber, said ceramic element thereby providing a coking zone in the firebox in front of said

element, a coke-burning zone in the firebox below the element, and a combustion chamber and a secondary air passageway within the element, said interior walls of the firebox including a rear wall, a stop member contiguous to said rear wall, said element including a rear wall portion resting upon said stop member by gravity, and fixed means in the roof of the firebox adjacent the secondary air inlet supporting said element against forward rotational movement.

3. A down-draft furnace having interior walls including a bottom grate defining a firebox, a roof at the top of the firebox, an air inlet through the bottom of the firebox, the rear wall of the firebox being substantially vertical and the roof thereof including a secondary air inlet communicating with the atmosphere and terminating medially in the roof, a pair of transverse spaced downwardly depending flanges in the roof defining the outlet of the secondary air inlet, the more forward of the two flanges extending a predetermined distance below the other, a removable refractory element in the upper rear portion of the firebox having a passageway at the front of the element open at the bottom and communicating at the top with the secondary air inlet to define a secondary air passageway and having a second passageway behind the secondary air passageway open at top and bottom to define a combustion chamber, said ceramic element thereby providing a coking zone in the firebox in front of said element, a coke-burning zone in the firebox below the element and a secondary air passageway and combustion chamber within the element, a gas outlet at the top of the furnace, said combustion chamber communicating with the coke-burning zone at its lower end and with said gas outlet at its upper end, the secondary air passageway within the element being substantially parallel to the combustion chamber with the bottom of the secondary air passageway terminating at substantially the junction of the coking zone, the coke-burning zone and the combustion chamber, the front wall of said element defining one side of the secondary air passageway and terminating below the adjacent wall of said element by a predetermined distance which is substantially the same as the predetermined vertical distance between said flanges, a stop member contiguous to the rear wall of the firebox, said element resting by gravity at its rear lower edge upon said stop member and being supported at its front top edge by said flanges, and the back wall of said element being sloped inward from bottom to top to permit insertion and removal of the element.

4. A down-draft furnace having interior walls including a vertical rear wall and a bottom grate defining a firebox, a roof at the top of the firebox terminating in front of the said vertical rear wall to define a gas outlet, an air inlet through the bottom of the firebox, a secondary air inlet in the roof communicating with the atmosphere and having an opening to the firebox adjacent and in front of said gas outlet, fixed stop means carried by said roof and defining said secondary air inlet opening, a removable ceramic element disposed in the firebox above the bottom thereof and beneath said gas outlet, and resting against said stop means, said element having a substantially vertical combustion chamber and secondary air passageway within the element, said secondary air passageway communicating with the secondary air opening in the roof and with the firebox and the combustion chamber communicating with the gas outlet and with the firebox, with said ceramic element thereby providing a coke-burning zone below the element, a coking zone beside the element, and a secondary air passageway and a combustion chamber within the element, a support member on the vertical rear wall of the furnace, said ceramic element including a rear wall resting on said support member and said element being removable by lifting the element from the support member and swinging the bottom of the element forwardly.

5. A furnace as set forth in claim 4, in which the stop means include a pair of vertically and horizontally spaced downwardly depending flanges, and the element has walls spaced from each other to define said secondary air passageway, said walls of the secondary air passageway engaging each of said stop means to seal the connection of said secondary air inlet and secondary air passageway.

6. A down-draft furnace having interior walls including a rear wall defining a firebox, a roof at the top of the firebox, an air inlet through the bottom of the firebox, the rear wall of the firebox being substantially vertical and the roof thereof including a secondary air inlet communicating with the atmosphere and terminating medially in the roof, a pair of transverse spaced downwardly depending flanges in the roof defining the outlet of the secondary air inlet, the more forward of the two flanges extending a predetermined distance below the other, a gas outlet between the more rearward flange and said rear wall of the firebox, a removable refractory element in the firebox beneath the gas outlet, said element being above the bottom of the firebox and thereby providing a coking zone beside the element and a coke-burning zone below the element, a secondary air passageway and combustion chamber within said element, said combustion chamber communicating with the coke-burning zone at its lower end and with said gas outlet at its upper end, the secondary air passageway being substantially parallel to the combustion chamber and communicating at its top adjacent said flanges with the secondary air inlet and at its bottom terminating at substantially the junction of the coking zone, the coke-burning zone and the bottom of the combustion chamber, the front wall of said element defining one side of the secondary air passageway and terminating at the top below another wall of said element defining the opposite side of the secondary air passageway and the adjacent side of the combustion chamber by a distance which is substantially the same as the vertical distance between the bottoms of said flanges; said element resting by gravity at its rear lower edge upon a portion of the furnace wall and being supported against forward rotation at its front top edge by at least one of said flanges, said element being removable by lifting the element from said portion of the furnace wall and swinging the bottom of the element forwardly.

JULIAN ROBERT FELLOWS.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,295,781	Fellows et al.	Sept. 15, 1942
2,370,644	Esson	Mar. 6, 1945