

Aug. 4, 1936.

W. A. RIDDELL

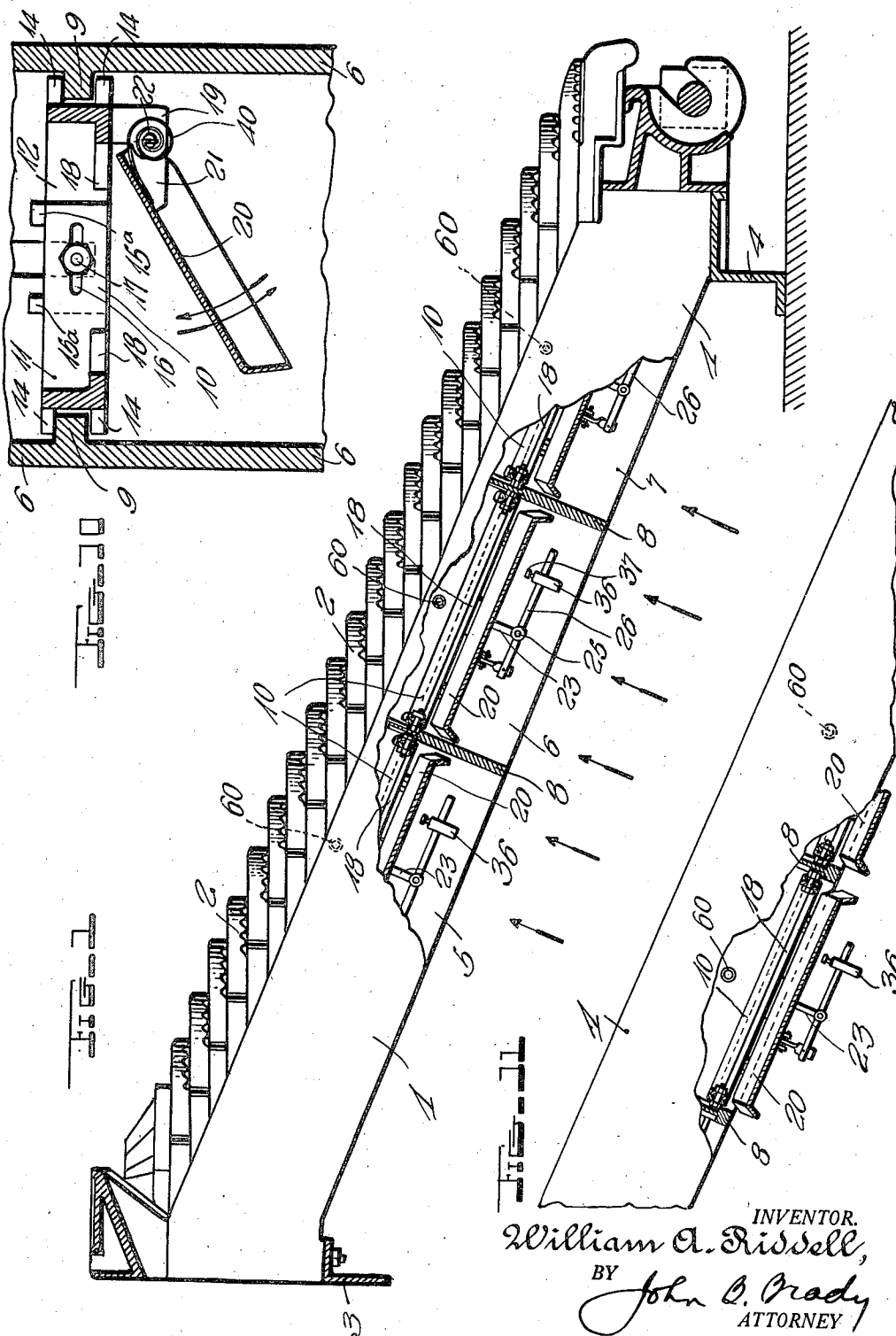
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METHOD AND APPARATUS FOR CONTROLLING COMBUSTION

IN MULTIPLE AND SINGLE RETORT STOKERS

Filed May 15, 1935

4 Sheets-Sheet 1



Aug. 4, 1936.

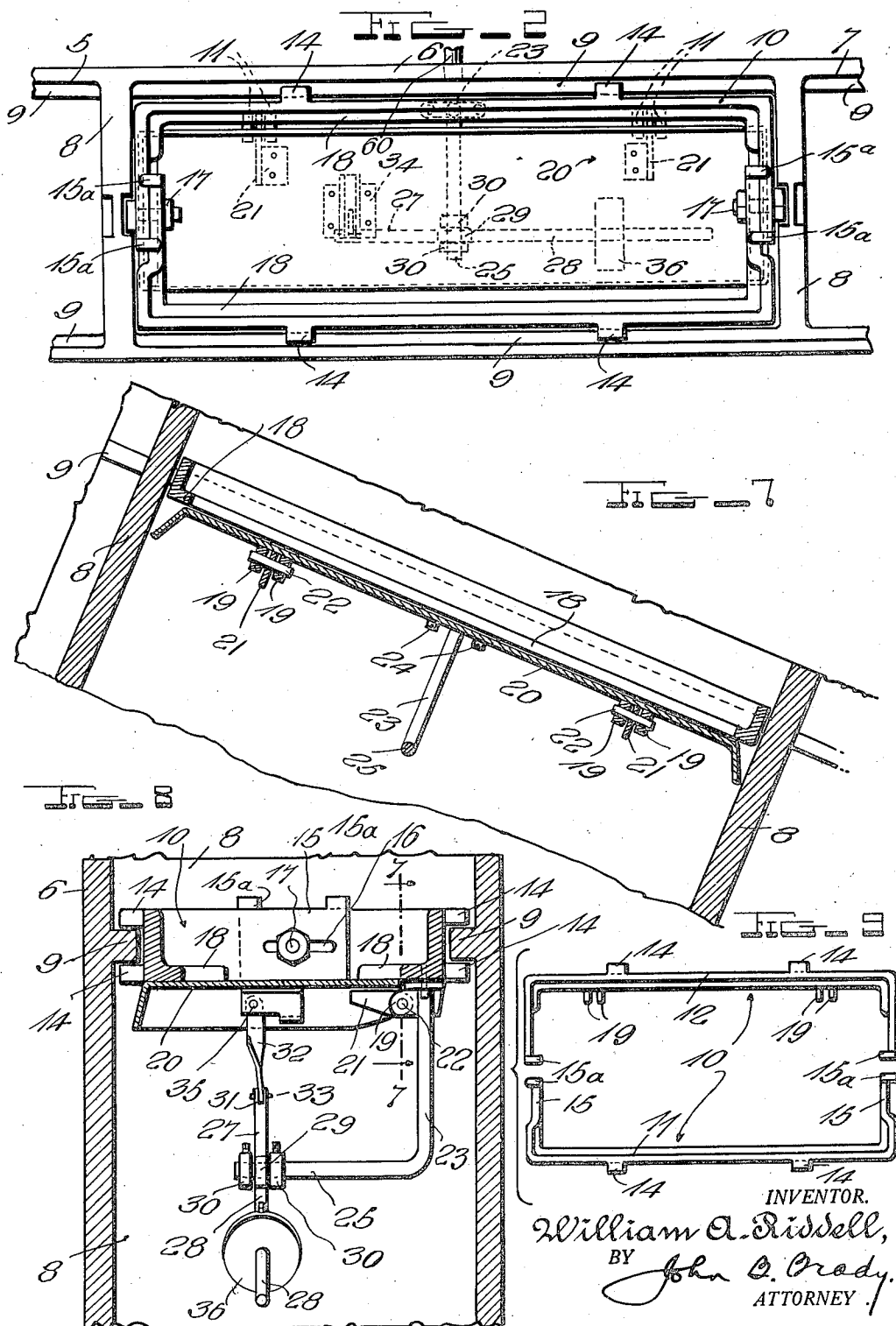
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4 Sheets-Sheet 2



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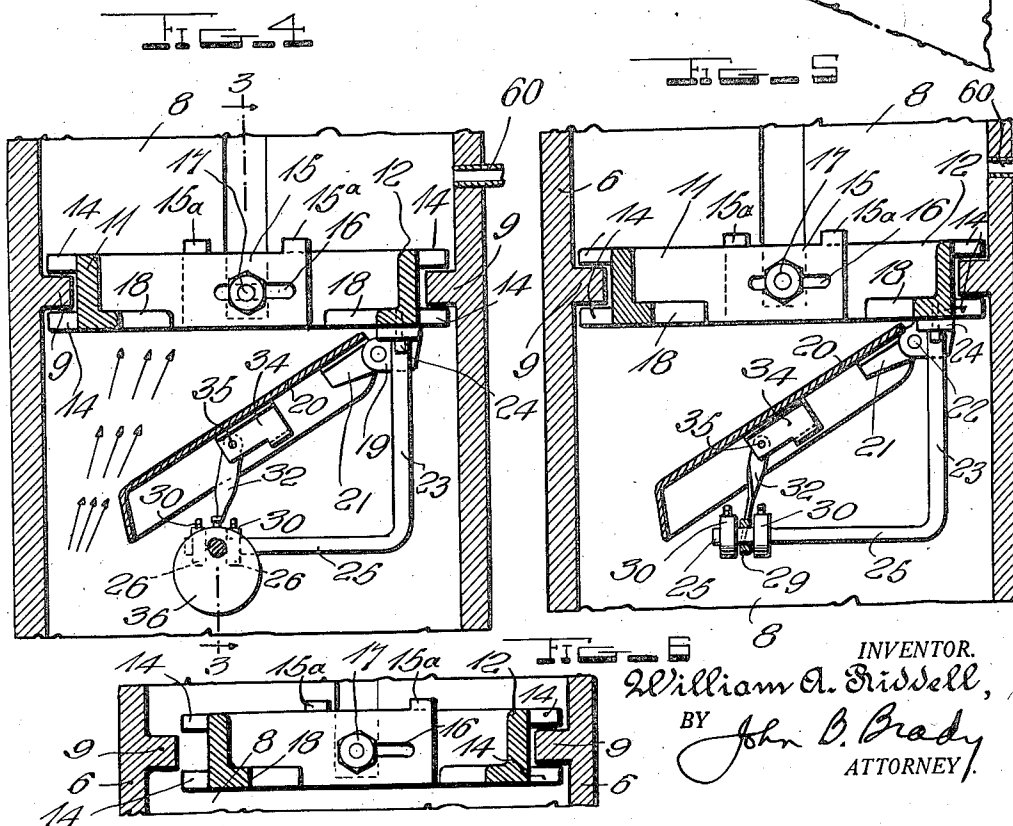
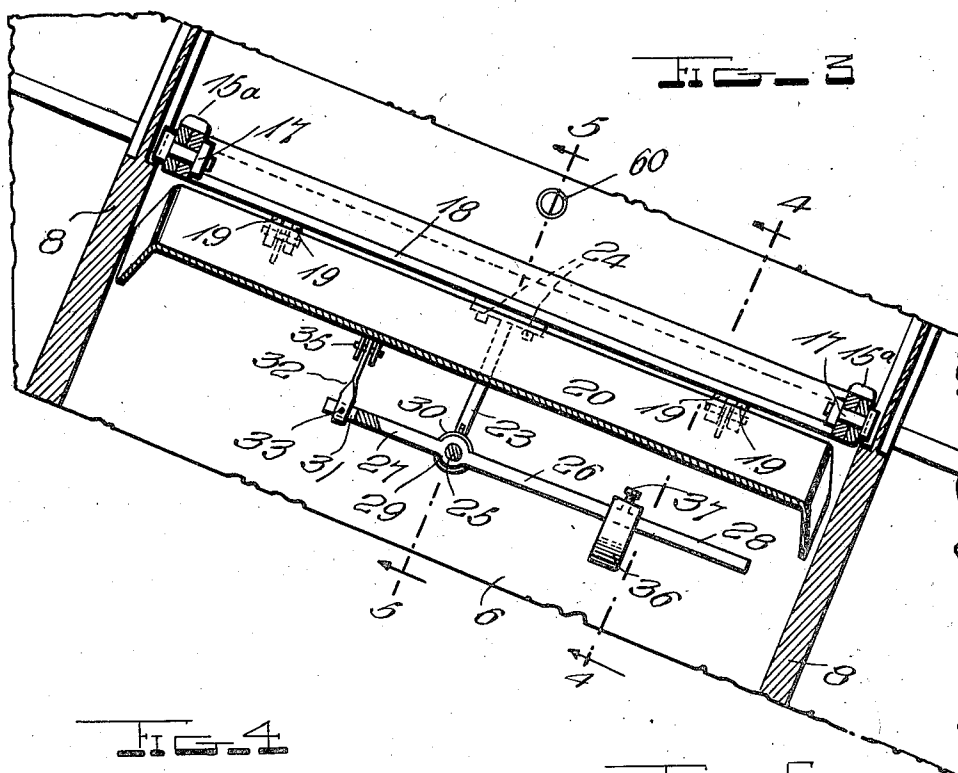
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Fig. 12

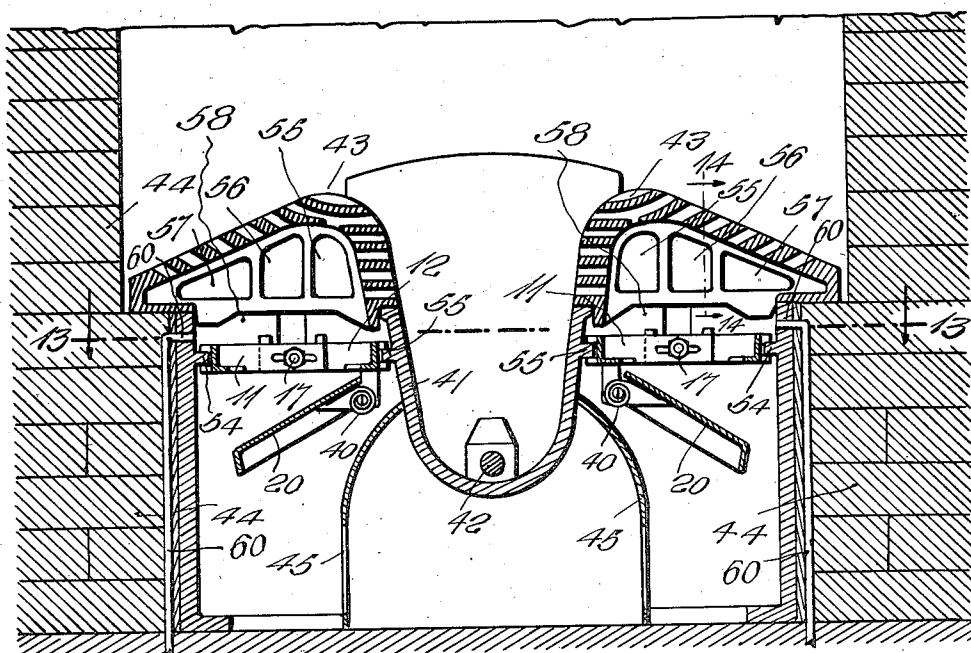


Fig. 13

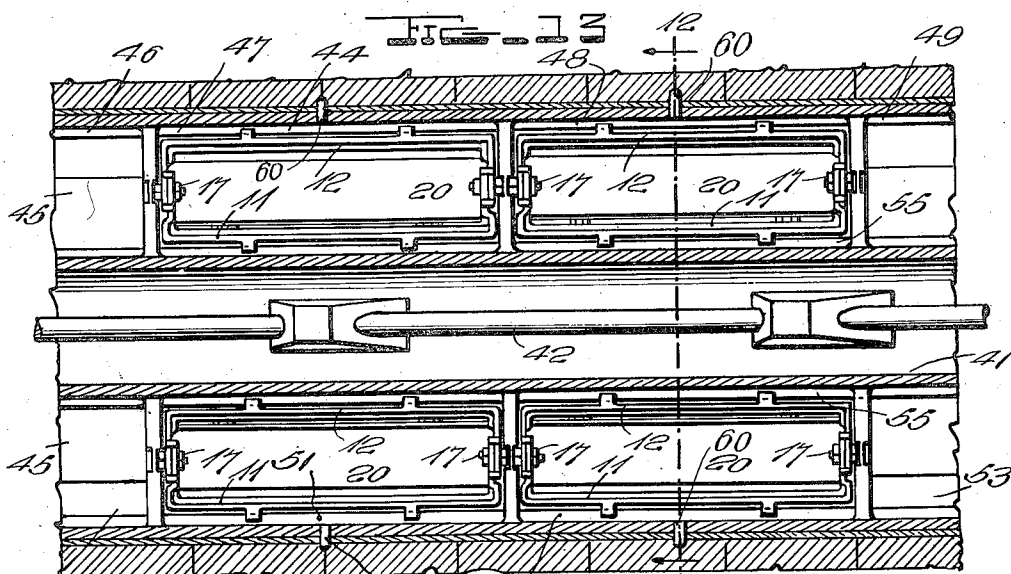
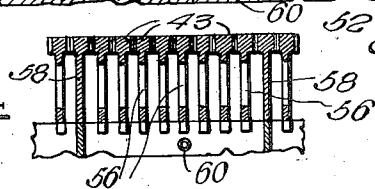


Fig. 14



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UNITED STATES PATENT OFFICE

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METHOD AND APPARATUS FOR CONTROLLING COMBUSTION IN MULTIPLE AND SINGLE RETORT STOKERS

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Application May 15, 1935, Serial No. 21,616

2 Claims. (Cl. 137—152)

My invention relates broadly to furnaces and more particularly to a method and apparatus for controlling combustion in multiple or single retort stokers.

5 One of the objects of my invention is to provide a method for automatically controlling the supply of air to the tuyères of a multiple or single retort stoker for insuring uniform and economical combustion.

10 Another object of my invention is to provide a construction of multiple or single retort stoker having means for controlling the velocity of air supplied to each section of the retorts of the stoker and controlling the pressure on each section and by so doing preventing the air from 15 blowing holes in the fuel bed.

Still another object of my invention is to provide a construction of balanced or spring tensioned valve system for multiple or single retort 20 stokers by which the volume and velocity of air supplied to the sections of the retorts may be controlled.

A further object of my invention is to provide a construction of valve which may be adjustably 25 mounted in different sections of multiple or single retort stokers of various designs for automatically regulating the feeding of air to the tuyères.

A still further object of my invention is to provide a construction of counterweight or spring 30 tensioned system for an automatic valve structure operative to control a supply of air to the different sections of a multiple or single retort stoker.

35 Other and further objects of my invention reside in the counterweighted or spring operated valve structure for multiple or single retort stokers as set forth more fully in the specification hereinafter following by reference to the accom- 40 panying drawings, in which:

Figure 1 is a side elevation partially broken away and illustrated in section and showing the balanced valve structure of my invention mounted in three adjacent sections of a retort; Fig. 2 45 is a fragmentary plan view of one section of a retort showing the balanced valve of my invention mounted therein; Fig. 3 is a substantially central vertical longitudinal section through the tuyère box taken on line 3—3 of Fig. 4; Fig. 4 50 is a transverse vertical section taken substantially on line 4—4 of Fig. 3; Fig. 5 is a transverse vertical section taken substantially on line 5—5 of Fig. 3; Fig. 6 is a fragmentary transverse vertical section showing more particularly the ad- 55 justable construction of the frame which carries

the valve; Fig. 7 is a longitudinal section taken substantially on line 7—7 of Fig. 8 showing the valve in closed position under excessive velocity of the air supplied to the tuyère boxes; Fig. 8 5 is a transverse vertical section showing the valve in closed position which occurs when the fuel bed becomes thin and tends to blow out in spots over the tuyères; Fig. 9 is a disassembled plan view showing the adjustable frame members by which the valves may be mounted in tuyère boxes of 10 various designs; Fig. 10 shows a modified form of valve in which the valve is tensioned by means of a spring element; Fig. 11 shows a further modified arrangement of valve for a retort wherein the valve is mounted in the extreme base of 15 the retort; Fig. 12 is a lateral sectional view taken on line 12—12 of Fig. 13 showing the application of my invention to single retort stokers, the cross-sectional view being taken intermediate the length of the enclosed sections; Fig. 13 is a horizontal 20 longitudinal sectional view taken on line 13—13 of Fig. 12 and showing the arrangement of valves in a single retort stoker for controlling the flow of air through the tuyères; and Fig. 14 is a 25 vertical sectional view taken through one of the sections of the retort and showing the end walls which serve to enclose the individual sections of the retort.

In the operation of a multiple or single retort stoker working under forced air pressure, diffi- 30 culty is often experienced in maintaining a uniform fire bed over the tuyères. Due to the non-uniform characteristics of the fuel and other conditions, there is a tendency of non-uniform 35 combustion over the fuel bed. The non-uniformity of combustion often results in the blowing out of the fuel bed in spots with the resulting loss of fuel and drop in temperature as well as the danger of exposing the tuyères and burning them out. After extended research, I have 40 found that combustion in multiple retort stokers may be controlled by dividing the retorts into independent sections and mounting in each of the independent sections a balanced or spring 45 actuated valve mechanism by which the air supplied to the different sections of the retort may be automatically controlled. This structure has a distinct advantage in that should a section of the tuyères in a single or multiple retort stoker be burned out or through, with an accompan- 50 ing hole through which unused air would blow, the structure of my invention provides for the automatic closing off of the burned out section. Thus, a furnace may be continued in use regardless of the fact that certain sections may be 55

burned out. This is a great advantage in large power units where it is expensive and impracticable to shut a boiler or furnace down on short notice. The valves are each precisely balanced to insure the closing of the valves upon increase in the velocity of air flow. Each valve is independently adjustable so that it will automatically close under a predetermined increase in velocity or pressure of air. The automatic closing of the valves in the different sections of the multiple or single retorts prevents the blowing of holes in the fuel bed and insures a maintenance of a uniform fuel bed. As the fuel bed tends to thin out at any position over the tuyères, the velocity of air tends to increase within the area of the thinning out process, above one or more of the sections of the retorts resulting in the automatic closing of the balanced or spring tensioned valves. This operation allows the rebuilding of the fuel bed automatically and controls the uniform combustion of the fuel. I have found that the air is equalized over the entire area of the fuel bed thereby increasing the efficiency of combustion and economizing on the consumption of fuel.

I provide a uniform velocity throughout the fire bed which is equivalent to a pressure of from $\frac{1}{4}$ " to $4\frac{1}{2}$ " more or less of water as measured by a gauge.

My invention will be more clearly understood by detailed reference to the drawings in which one of the retorts has been illustrated in Fig. 1 by reference character 1 supported adjacent its upper end by support 3 and adjacent its lower end by support 4. The retort forms a tuyère box on which the tuyères 2 are mounted and over which the fuel is automatically supplied. The retort is divided into a section or sections according to my invention, which sections I have illustrated by way of example at 5, 6 and 7. The number of sections may be increased or diminished, and in illustrating the three sections I desire that it be understood that the arrangement shown is for illustrative purposes only. The sections are disposed between the lateral partition members 8 in the retort. The retort is provided with longitudinally extending inwardly directed ribs 9 which provide means for mounting the valves in each of the sections of the retort as will be more fully described hereinafter. The valves are mounted in the sections of the retort by means of an adjustable frame 10 having complementary portions 11 and 12, each of which contain peripheral outwardly directed lugs 14 which engage opposite sides of the inwardly directed longitudinally extending ribs 9. Because of the fact that the portions 11 and 12 of the frame 10 may be collapsed with respect to each other in substantially a telescopic manner it will be readily observed that the portions 11 and 12 may be inserted beneath the sections of the retort, moved upwardly therein, and then laterally expanded with the coacting lateral portions 15 of the frame 10 abutting face to face and adjustable within the guides constituted by members 15a. When the portions 11 and 12 of the frame 10 have been moved to their extreme extended limits the portions 11 and 12 are firmly secured by bolt member 17 which extends through aligned slot 16 in lateral portions 15.

The frame 10 after being located in position in the section of the retort in which the valve is to be supported is rigidly secured by means of the nut and bolt 17 extending through the aligned slots 16. The complementary sections 11 and 12 of the frame 10 are provided with the peripheral

ribs 18 which serve as an abutment against which the valve closure member 20 is moved. The valve closure member 20 extends laterally across the frame 10 when in closed position. Hinge members 21 connected to the valve closure member 20 are connected to the lugs 19 formed on the portion 12 of frame 10 by means of pins 22. The valve closure member 20 is thereby arranged to move through a circular space about pins 22 as pivots. I provide a depending support 23 secured to the portion 12 of the frame 10 by suitable plate and bolt connections 24. The support 23 depends downwardly in a substantially vertical direction for a distance substantially equal to the width of the valve closure member 20 and is then bent substantially at right angles and extends substantially more than midway of the center of the valve closure member 20 as shown at 25. The extremity of the depending member at 25 serves as a pivotal support for the lever 26. The lever 26 has a relatively short arm 27 and a relatively longer arm 28. The fulcrum for the lever 26 is enlarged as shown at 29 so as to wholly encircle the portion 25 of depending member 23. Limiting stops 30 are secured on each side of the fulcrum 29 for determining the position of the pivotally mounted lever 26.

The lever 27 has the end thereof slotted as indicated at 31 to receive the end of the link 32. The link 32 is pivotally connected to the bifurcated end of lever 31 by means of link 33. The other end of link 32 is pivotally connected to valve closure member 20 and bracket member 34 through pin 35. Bracket member 34 is secured to the rear of the flat valve closure member 20. The lever 28 provides means for supporting the adjustable weight 36 which may be moved to selected positions and set in the selected position by means of set screw 37. By regulating the position of the adjustable weight 36 with respect to lever 28 the pressure at which the valve closure member 20 closes may be readily controlled. That is to say, by shifting the adjustable weight 36 toward the extremity of lever 28 the valve closure member 20 will remain open until the air reaches a velocity which is greater than the velocity which would normally move the valve closure member 20 to closed position if the adjustable weight 36 were moved inwardly along lever 28 to provide a shorter effective lever arm. By selectively fixing the position of adjustable weight 36 on lever 28, the pressure at which the air will close the valve closure member 20 may be regulated. By reason of this flexibility of adjustment, combustion over the entire fuel bed may be maintained uniform. The increase in velocity of air in any localized area of the fuel bed is prevented from detrimentally affecting the structure of the fuel bed when employing the protective valve system of my invention. I have indicated in Fig. 4 the manner in which air is supplied to the tuyères through the sections of the retort with the valve open. In Fig. 8 the manner in which the velocity of flow of the air is arrested has been shown with the valve closure member 20 shifted to closed position.

In Figure 10, I have illustrated a modified form of valve wherein the balanced lever mechanism is eliminated and in lieu thereof, tension members 40 in the form of springs are interposed between the lugs 19 or pins 22 carried thereby and the hinge members 21 in a position tending to yieldingly maintain valve 20 in an open position. Upon increase in the velocity of flow, valve 20 is

closed against the peripheral seat 18 in a manner heretofore described.

Moreover, it is unnecessary that the valves be installed in a position substantially central of the sections of the retort as I may mount the valves as illustrated in Fig. 11 where the peripheral seat 18 which provides a seal against which valve 20 seats is substantially in a plane with the lower limit of the retort. This arrangement facilitates installation, adjustment, and repair of the valve structure.

By adjustment of the valves in the system of my invention, I meet various conditions required for combustion and particularly I am able to maintain a velocity of flow of air under a pressure bed ranging from one-fourth inch to four inches measured by means of a column of water. By selecting a desired pressure and velocity of flow, uniform economical combustion may be maintained.

Figs. 12 and 13 show my invention as applied to a single retort wherein the retort has been indicated generally at 41 with pusher bar 42 operating therein for feeding fuel which is delivered to the combustion area of the retort over the tuyères designated generally at 43. The tuyères 43 are supported in predetermined relation with respect to the furnace structure 44 and above the wind box 45. The tuyères 43 are cast with a web-like support beneath the surface which supports the fuel bed. End walls 58 which are solid in construction are provided under those tuyères which define the limits of each section of the retort. The web-like supports for the intermediate tuyères are perforated as represented at 55, 56 and 57. Thus, a box-like section is formed through which air flows within the confined limits of each section. The associated valve 20, when closed, cuts off the air supply to each section and in any other intermediate position serves to control the supply of air which flows through the sections of the tuyères. Each section of the tuyères includes means for supporting a valve carrier. I have shown the retort divided into sections above the wind box and immediately below the tuyères at 46, 47, 48, 49, 50, 51, 52, 53, etc. In each of these sections, there is mounted a frame structure 10 consisting of frames 11-12 having lugs adapted to grip opposite faces of flanges 54, on wind box 45 and flanges 55 on retort 41. The frames 11 and 12 which support the valves 20 are each similar to the frames heretofore described and are secured by bolt and nut connection 17 in a manner similar to the method of mounting the valves as heretofore described. I may employ the tension spring arrangement 40 as described in more detail in connection with Figure 10 or I may employ the balanced valve arrangement as described more particularly in connection with Figs. 3, 4 and 5. For the purpose of illustration, I have selected a tension spring arrangement 40 which shows the valves 20 normally tensioned to open position and disposed in planes inclined opposite to each other. The tension on the valves 20 is such that a predetermined velocity of flow of air may be maintained through the tuyères and under any conditions where an increase of pressure should occur by reason of the blowing out of the fire bed, the arrangement of valves of my invention automatically equalizes the pressure. Upon the burning out of any tuyères, either in the multiple or single retort structure of my invention, the furnace may be continued in operation until such a time as is practical to shut down the furnace for repairs

for it is possible to continue the operation of the furnace with a smaller number of tuyères active and with the burned out tuyères automatically cut out so far as the escape of draft through the fuel bed is concerned.

In order to indicate the condition of the fire bed within the furnace at all times, I provide a gauge glass system mounted adjacent the front of the furnace including sets of U tubes corresponding in number to the sections of each of the retorts. One end of each U tube is connected through a pipe with a tap which I have indicated in the drawings by reference character 60. The tap 60 is located in each section of the retort below the tuyères so that the pressure in each section may be applied to the U tube at the front of the furnace. I have shown the tap 60 in the several figures of the drawings located at the positions as will insure the advocacy of pressure existing in the section of the retort to a corresponding U tube at the front of the furnace. In installations wherein there are three control valves and sections for each retort, I provide three separate U tubes to show the condition existing in the several sections of that retort. Corresponding U tubes are provided for the other sections of the retort. Suitably colored fluid is provided in each U tube and for all normal conditions of air pressure through the tuyères, the level of the fluid in all of the U tubes is raised to a similar level. However, should a blow-out occur in the fire bed, the pressure increases to such an extent that the valve in the section below the tuyères which have blown out is automatically closed, resulting in the dropping of pressure in that section which is immediately noted by the dropping of the level of the fluid in the associated U tube at the front of the furnace. If the fire bed does not automatically rebuild under operation of the stoker and an excessive number of blow-outs occur, the operator is informed by the glass gauge system of the necessity of shutting down the furnace for repair.

I have found the method and apparatus of my invention highly effective in increasing the efficiency of operation of multiple and single retort stokers. It will be understood that the structure of the valve mechanism illustrated herein may be readily modified to allow the valve mechanism to be applied to various types of retorts and tuyère boxes. The construction selected herein for illustrating my invention is not intended as a limitation upon my invention, but merely for purposes of illustrating one form of my invention. For example, it is not necessary that retorts be employed which have a rib 9 secured thereto. Moreover, frames 10 are not necessarily adjustable. I may also find it desirable to pivot the valves 20 so that the valves move in a longitudinal plane, that is, the valves may be pivoted adjacent one end and may swing downwardly into the wind box in a position to be automatically moved to closed position upon increase in pressure and velocity of flow of the air. Thus, it will be seen that many rearrangements and modifications of my invention may be made.

I intend that no limitations be placed upon my invention other than those imposed by the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is as follows:

1. An air flow control for retorts comprising a frame structure engageable with a retort, an air valve hingedly mounted with respect to said frame structure, a supporting member depending

from said frame structure, a balancing lever pivotally mounted on said supporting member and hingedly connected with said air valve, and an adjustable weight carried by said lever for pre-
5 determining the opening or closing of the air valve according to the velocity of flow of air through the retort.

2. An air flow control for retorts comprising an adjustable frame structure engageable with a
10 retort, a laterally extending peripheral seat on

said frame structure, a flat valve hinged adjacent one side thereof to said frame structure and swingable to a position engaging said valve seat for shutting off the supply of air to the retort,
5 a supporting member depending from said valve seat, a lever fulcrumed on said supporting member, a pivotal connection between one end of said lever and said valve, and an adjustable counterweight on the other end of said lever.

WILLIAM A. RIDDELL. 10