Jan. 14, 1941. A. DRUMMOND 2,228,758

DRAFT REGULATING METHOD AND MEANS

Original Filed Nov. 23, 1937 3 Sheets-Sheet 1

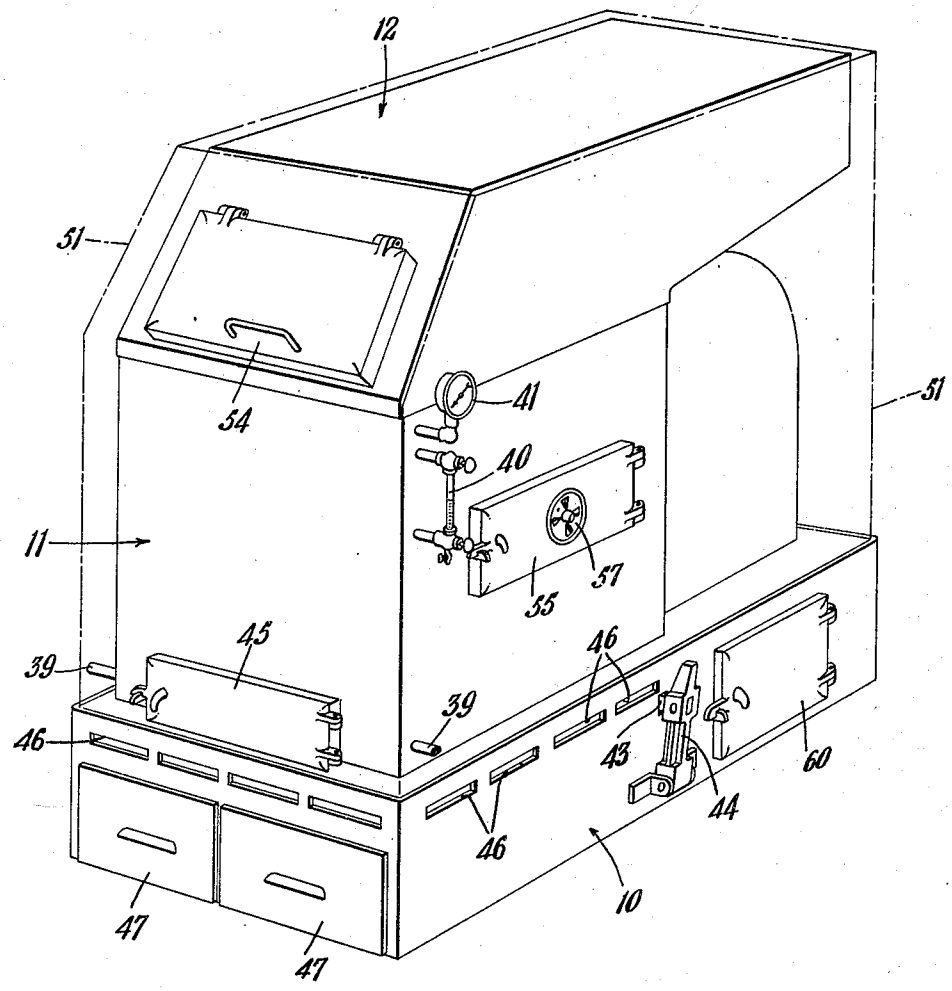


Fig. 1.

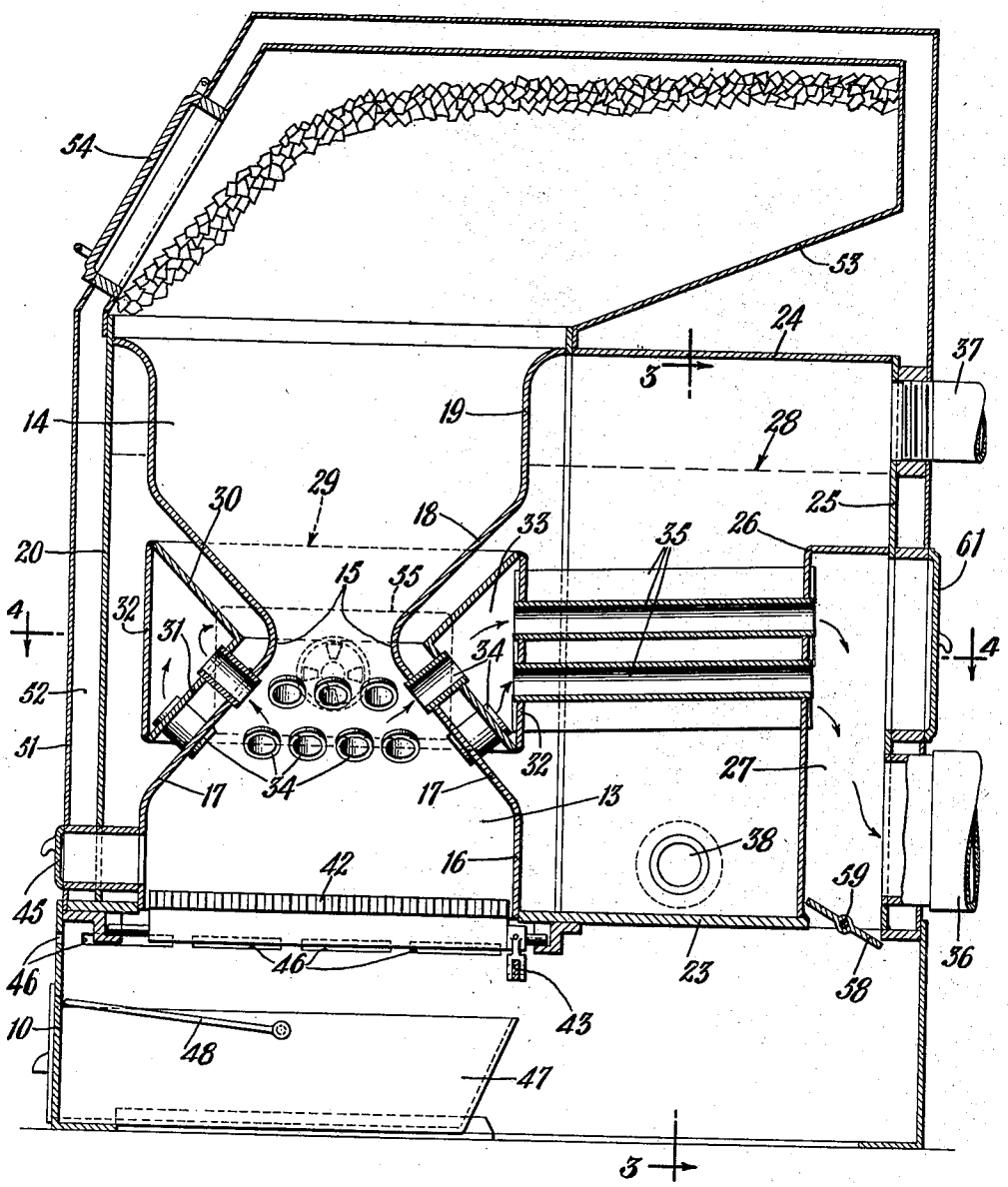
Inventor
Andrew Drummond
by H. C. Diserens
Attorney

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Fig. 2.



Inventor

Andrew Drummond

by H. C. Miesenz

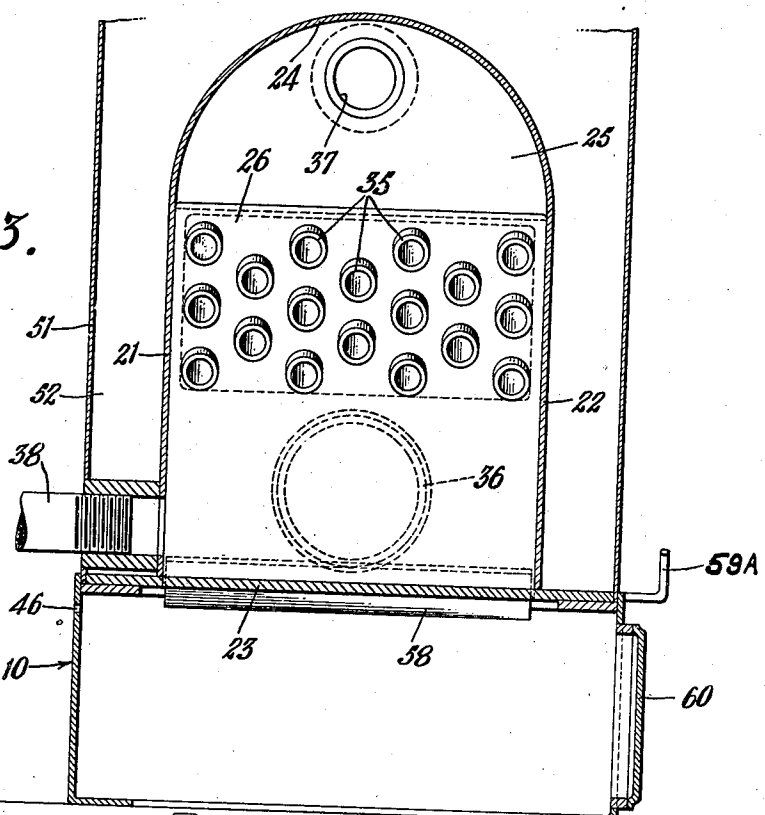
Attorney

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DRAFT REGULATING METHOD AND MEANS

Original Filed Nov. 23, 1937 3 Sheets-Sheet 3

Fig. 3.



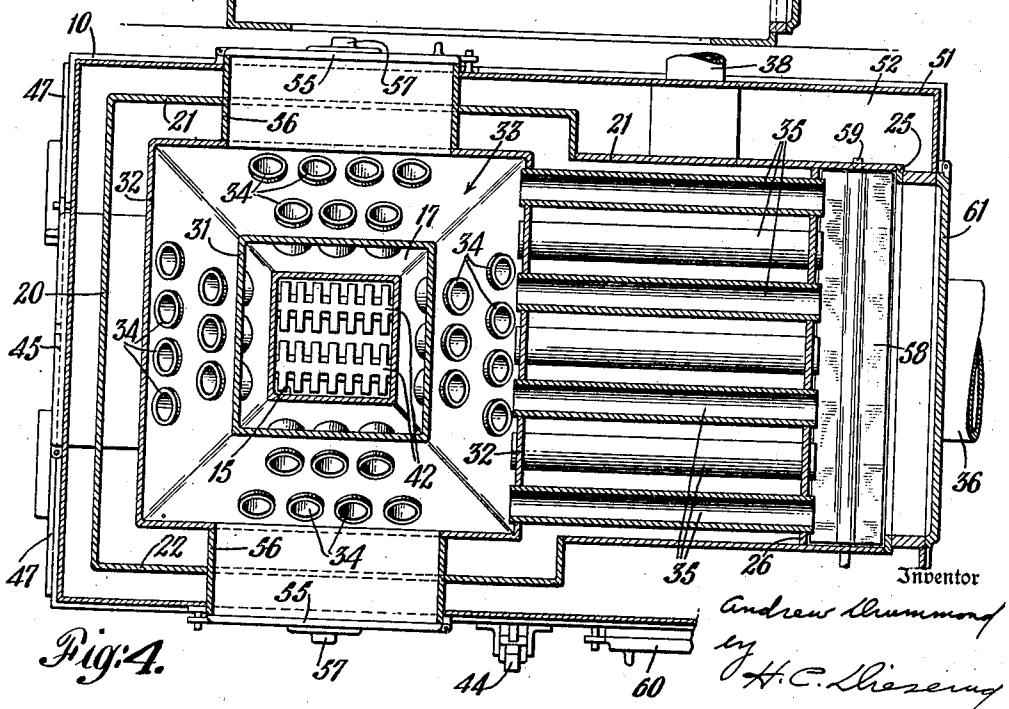


Fig. 4.

Inventor
Andrew Drummond
by H. C. Riesenberg
Attorney

Patented Jan. 14, 1941 2,228,758

UNITED STATES PATENT OFFICE

2,228,758

DRAFT REGULATING METHOD AND MEANS

Andrew Drummond, St. George, Staten Island, N. Y., assignor to Lehigh Valley Coal Sales Company, New York, N. Y., a corporation of New Jersey

Original application November 23, 1937, Serial No. 176,147. Divided and this application September 15, 1938, Serial No. 230,000

5 Claims. (Cl. 110—147)

This invention relates to improvements in boiler or furnace construction, particularly of the type suitable for domestic or home heating use, although its features may be applied also to larger installations.

This is a division of my pending application Ser. No. 176,147, filed on November 23, 1937. While the invention of the present case is especially suited for use in connection with a boiler of the type disclosed and claimed in the parent case, it will be understood that it is capable of application to a wide variety of other types of boilers and furnaces.

A primary object of the present invention is the provision of an improved and simplified method of and means for controlling or regulating the draft in a heating unit of the character specified.

A special feature of the control system is that a single damper is adapted to regulate the rate of combustion. The arrangement is such that when maximum combustion is desired, all of the air flowing as the result of the chimney draft passes through the fuel bed whereas when a lesser rate of combustion is desired, a part of the chimney draft is diverted or by-passed so that only a desired portion of the total air drawn by the chimney passes through the fuel bed. As a further feature of this control system, the air that is by-passed and, therefore, not drawn through the fuel bed is, nevertheless, brought into contact with the grate bars and is, in fact, drawn across the bottom thereof so as to impart a cooling effect to the grates. This is an important advantage inasmuch as it more or less completely obviates the formation of clinkers and minimizes the danger of warping or burning out the grates, which frequently happens when the heat is bottled up in the ash-pit as the fire is banked in a furnace of usual construction.

In the operation of the improved control system, furthermore, the draft of the chimney is never choked off. It is always permitted to have its full effect and the damper merely regulates the amount of air drawn through the fuel bed by increasing or decreasing the resistance to the flow of air past the damper from beneath the grate bars. An advantage of this arrangement is that the combustion chamber is always left in open communication with the chimney and hence the danger of building up a back pressure in the combustion chamber, causing the leakage of coal gases from the furnace, is completely avoided.

Other objects and advantages of the invention will appear from the detailed description of an illustrative embodiment of the same which will now be given in conjunction with the accompanying drawings, in which:

Fig. 1 is a perspective view of the improved boiler as seen from the front and one side, an outer shell or casing surrounding the unit being omitted but indicated in broken outline.

Fig. 2 is a central, longitudinal, vertical section through the boiler.

Fig. 3 is a transverse, vertical section taken along the line 3—3 of Fig. 2, the upper or magazine portion of the boiler being omitted, and

Fig. 4 is a horizontal section taken along the line 4—4 of Fig. 2.

Referring now to the drawings, the illustrative boiler, to which the improved control system has been shown applied, may be said to consist of three principal portions, namely a base 10 forming the ash-pit of the unit, a main boiler portion 11, and a magazine portion 12. The base is a box-like member and may be formed either of cast iron or of sheet iron or steel, suitably bent and welded or otherwise fastened to provide a sturdy supporting structure. The magazine portion 12 is adapted to retain an adequate supply of solid fuel, such as coal, to enable operation of the boiler continuously over a period of at least twenty-four hours and in milder weather, or at times when the furnace is largely banked, over considerably longer periods.

Turning first to the main boiler portion 11, this includes a combustion chamber 13, in which the fuel is ignited and permitted to burn at an appropriate rate, and a fuel supply member or hopper 14 in open communication with the combustion chamber and arranged to deliver fuel to the latter through a restricted throat or passage 15. The combustion chamber and the hopper may be of any suitable form, in horizontal cross-section. In the unit illustrated, these parts are square in horizontal cross-section but it will be clear that they might be of rectangular or other polygonal form or circular or oval or of any other suitable shape. The lower portion of the combustion chamber is preferably enclosed by a vertically disposed wall or series of connected walls 16 while the upper portion of this chamber is formed by an inclined wall or series of connected walls 17. The latter are preferably inclined upwardly and inwardly at an angle of about 45°, which is substantially at the angle of repose of the fuel intended to be consumed in the combustion chamber. While the improved boiler is adapted to utilize a large variety of different

forms and sizes of solid fuel, it is particularly suited for the consumption of anthracite coal of the size generally designated "Chestnut." By sloping the top wall or crown 17 of the combustion chamber, at substantially the angle of repose of the fuel, it is insured that the fuel will entirely fill said combusion chamber and spread out more or less uniformly over the entire area of the lower portion of the combustion chamber so that there will be substantially no air or gas space above the fuel within the combustion chamber.

The fresh fuel is constantly supplied to the combustion chamber from the hopper and associated magazine through the restricted opening 15. For this purpose the bottom wall 18 of the hopper is extended outwardly and upwardly from the throat 15 at an angle of about 45° and then preferably merges into a vertically extending wall or series of connected walls 19.

Surrounding the combustion chamber and hopper of the boiler is a water and steam-tight jacket comprised by a front wall 20, side walls 21 and 22, a bottom 23, a top 24, and a rear wall 25 having a portion 26 set in from the back of the boiler to form a flue-gas header 27. In the operation of the unit, the space within the jacket just described is maintained filled with water to about the level indicated by the broken line 28 in Fig. 2. It will thus be seen that the water substantially completely surrounds the combustion chamber and the tubes in the economizer section and also surrounds a portion of the hopper. That portion of the space within the jacket above the water level constitutes the steam space when the boiler is employed in connection with a steam heating system. If desired, the boiler may be employed in a hot water heating system in which case the entire space within the jacket will, of course, be filled with water.

Surrounding the top portion of the combustion chamber and the lower portion of the hopper or, in other words, surrounding the restricted portion of the hour-glass construction formed by the combustion chamber and hopper, is a secondary combustion chamber 29. This chamber is formed by a top wall or series of connected walls 30, parallel with but spaced slightly from the bottom wall 18 of the hopper, a wall or series of walls 31, parallel with but spaced slightly from the top wall 17 of the combustion chamber, and an outer wall or series of connected walls 32, vertically disposed in substantially the same planes as the walls 16 and 19 of the combustion chamber and hopper, respectively. In this way there is completely enclosed a secondary combustion zone 33 surrounding the restricted portion of the hour-glass construction.

A series of short tubes 34, passing through the wall or walls 17 and the wall or walls 31, and having their ends secured to these walls, provides a communication between the top of the main combustion chamber 13 and the secondary combustion zone 33. A sufficient number of tubes 34 of suitable diameter should be provided to insure the ready removal from the main combustion zone of the gases resulting from combustion as well as gases distilled from the fuel. These latter gases, and in fact any burnable constituents in the gases developed in the main combustion zone, are subjected to further combustion in the secondary combustion zone, into which the appropriate amount of air to support the further combustion is introduced through suitable openings, to be described hereinafter. The more or less fully burned gases are discharged from the secondary combustion zone through a series of tubes 35 of appropriate number and diameter to enable free passage of the gases into the header 27. From the latter the gases are discharged through a duct or flue 36 into a chimney, not shown.

In the operation of the boiler, heat developed by the combustion of the fuel will be transferred to the water within the jacket, previously described, through the walls of the main combustion chamber and through the walls of the sets of tubes 34 and 35. Moreover, it will be apparent that a circulation of the water will be established by convection through the passage formed between the secondary combustion chamber and the walls 17 and 18. In this way the heat will be transferred more or less uniformly to all portions of the body of water. Steam generated during the operation of the unit may be withdrawn through a pipe 37 to the radiators, or other steam-consuming devices, and the condensate may be returned to the bottom of the boiler through a return pipe 38. Fresh water may be introduced into the system whenever necessary through a supply pipe 39 provided at the front end of the boiler, as shown in Fig. 1. A water gauge 40 of any conventional form may be provided to indicate the level of the water in the boiler and a steam gauge 41 of conventional form may also be employed to indicate the pressure of the steam developed. Other accessory devices commonly employed, such as safety blow-off valves and the like, may be utilized.

Any suitable form of grate structure may be employed at the bottom of the main combustion chamber. For example, a series of grate bars 42, of any conventional form, may be disposed from front to rear of the combustion chamber and these may be suitably mounted for a rocking motion in any convenient way. A connecting bar 43, associated with a shaking member 44 attached to the base portion of the furnace, may be employed in a manner well known, to transmit a rocking motion to the grate bars when it is desired to shake down the ashes. A clinker door 45 may be provided at the front of the furnace to give access to the upper surface of the grate bars for cleaning purposes.

Immediately below the grate bars the front and side walls of the base 10 of the boiler are conveniently provided with a series of slots or openings 46 through which air may freely enter the ash-pit portion of the boiler adjacent to the under surface of the grate bars. This, as will be explained more fully hereinafter, provides for an adequate supply of air to support the combustion of the fuel in the main combustion chamber and to cool the grate bars when the fire is banked.

To facilitate the removal of ashes from the boiler a pair of ash drawers 47 is preferably employed beneath the grate, the fronts of the drawers acting as ash-pit doors. These drawers, which may be of any suitable construction, such as the form best illustrated in Fig. 6, preferably have a sloping rear wall to enable a ready discharge of ashes into an ash-can or other receptacle at the appropriate time. Each drawer is provided with a handle in the form of a bail 48, preferably pivotally attached to the drawer at points adjacent to but slightly above the center of gravity of the drawer. These bails or

handles assist in carrying the drawers and in discharging their contents. If desired, the length of the bails may be such that the cross members will remain in a position out of the path of the ashes falling into the drawers as the grate is shaken. Any suitable guiding, spacing and supporting means may be provided for the drawers to facilitate their insertion and withdrawal.

For the dual purpose of improving the appearance of the boiler and of providing a convenient means for insulating the exposed walls of the boiler against the loss of heat by radiation, an outer shell of sheet metal, or the like, 51 is provided at the front, sides, top and back of the unit. The location of this shell is indicated in broken lines in Fig. 1 and the shell is indicated in cross-section in other views. As best shown in Figs. 2 and 3, the walls of the shell 51 are preferably substantially in vertical alignment with the walls of the base portion 10. An air space 52 is thus provided between the outer shell and the water and steam-retaining jacket previously described. This air space in itself provides some heat insulation but this insulation may be made more effective, if desired, by the use of a lining of sheet asbestos or the like (not shown) along the inner face of the sheet 51. It will be apparent that any other suitable form of insulation may be employed in lieu of that described, if desired.

The form of the fuel magazine 12 is clearly shown in the drawings. Its particular form and arrangement may be varied but it has been found that the particular form illustrated is advantageous for the reason that it permits the storage of a relatively large quantity of fuel without unduly increasing the size of the unit. Moreover, the arrangement shown is such that the overall height of the unit may be maintained within reasonable limits and the magazine is conveniently located for charging. As shown in Fig. 2, the bottom wall 53 of the magazine is preferably inclined at a suitable angle so as to insure the automatic feeding of the coal from the magazine into the hopper. The front of the magazine is preferably inclined from the vertical at a convenient angle so that when a charging door 54 is opened, the coal may be readily thrown into the magazine by means of a scuttle or shovel and distributed evenly over the space within the magazine. Moreover, with the arrangement shown, the door 54 will remain in either its closed or its open position by its own weight due to the location of the center of gravity with respect to the hinge axis.

At each side of the unit there is provided a door 55 which when opened affords access to the interior of the second combustion chamber. A passage 56 extends from each of the door seats to the wall 32 of the secondary combustion chamber. In each of the doors 55 a rotary damper 57 is preferably provided for the admission of a desired amount of air into the secondary combustion chamber to insure substantially complete combustion of the gases within this chamber.

As hereinbefore indicated, an extremely simple control or regulating means is provided. This is in the form of a single damper 58 pivotally mounted on trunnions 59 at the bottom of the flue-gas header 27. An arm 59A, formed as an extension of one of the trunnions of the damper, affords a convenient means for adjusting the damper, as desired. It will be clear that when the damper is closed, as indicated in Fig. 2, substantially the entire draft of the chimney will be effective to draw the air, admitted to the ash-pit through the openings 46, through the fuel in the main combustion chamber, and to draw the resulting gases through the tubes 34, into and through the secondary combustion chamber 29, at which point additional air may be supplied through the dampers 57, then through the tubes 35 into the header 27 and finally into the chimney. On the other hand, if the damper 58 is rotated into its wide-open or vertical position, the draft of the chimney will be substantially completely utilized in drawing the air directly along the line of least resistance,—that is through the openings 46 directly across the under surfaces of the grate bars, past the damper 58 into the flue 36. A small portion of the draft will at this time be effective in header 27 to remove from the main combustion chamber through tubes 35 any gases generated by the slow burning of the fuel but there will be no appreciable movement of air through the fuel bed due to the fact that the slight draft aforementioned will be largely, if not entirely, balanced by the suction effect downwardly through the grate produced by the movement of the air across the bottom surfaces of the grate bars. It will be clear that by adjusting the damper 58 to intermediate positions, the effect of the chimney draft in drawing air through the fuel bed may be varied or regulated to suit the particular requirements of the furnace at any given time.

Any appropriate means may be employed for regulating damper 58. The regulation may be partly or fully automatic or entirely manual. Automatic control may be effected in various ways, as by means of a steam-pressure-controlled diaphragm or by aquastatic or thermostatic means, or other conventional control devices may be employed. If the draft of the chimney is greater than required for maximum load conditions, an adjustable stop may be provided to prevent the complete closing of the damper.

Heretofore it has been the practice to utilize both a turn damper and a check damper in the flue connections between a boiler and a chimney and it has been customary to control the operation of the boiler largely by the adjustment of these dampers and of a damper in the ash-pit door. This has not only entailed a complicated system of connections for operating the various dampers, but has resulted in unsatisfactory control of the boiler for various reasons. In the first place, the closing of the turn damper in the flue connection tends to choke off the further discharge of gases from the furnace into the chimney and if an attempt is made to suddenly check the fire in this way after it has been burning briskly, there is danger that a slight pressure will be built up within the boiler gas passages, which may cause the escape of coal gases into the surrounding room. Furthermore, the ash-pit damper in a control system of this nature tends to more or less completely shut off the flow of air through or around the grate so that a great deal of heat is bottled up when the furnace is checked after a period of vigorous operation. This bottling of the heat is particularly objectionable when the fire has just been shaken down and a large quantity of red-hot cinders or coal is present in the ash-pit as well as in the combustion chamber. The high temperature created in the vicinity of the grate bars at such a time will tend to clinker the ash and will also tend to warp and burn out the grates.

The improved control system, on the other hand, obviates all of these difficulties. In the first place, the combustion chamber is never closed off from direct communication with the chimney so that no back pressure can possibly be created within the combustion chamber. In the second place, when the fire is checked by the opening of the damper 58, cool air is drawn across the bottom surfaces of the grate bars, thus preventing clinker formation and injury to the grate bars. It will be apparent that this relatively cool air passing to the chimney will also check the draft to substantially the same extent as air admitted through a check damper in the side of the flue pipe of a conventional installation.

In view of the possibility that a small amount of fine ash may be carried along with the air that is drawn across the under surfaces of the grate bars when the damper 58 is opened, provision is made for cleaning out the back portion of the ash-pit from time to time. For this purpose a door 60 is provided either at one side of the ash-pit or at the back. It will be found that substantially all of the fine ash carried by the air under these conditions will be dropped out at the rear of the ash-pit as the air is forced to sharply change its direction in passing into the header 27 and flue pipe 36.

In line with the tubes 35, a clean-out door 61 may be provided in the rear of the boiler so that access may be had to the tubes for cleaning the latter from time to time.

The operation of the boiler will be apparent from the foregoing detailed description and no resumé is believed to be necessary at this point. Suffice it to say that the only attention which the improved boiler requires, particularly if it is equipped with automatic regulating means for the control of the damper 58, is the occasional charging of the magazine 12 with a fresh supply of coal, an occasional shaking of the grates, and the occasional removal and emptying of the ash-drawers 47. During colder weather the magazine may be supplied with coal every day or every second day. During warmer weather, when the consumption of the furnace is relatively low, the magazine need be filled only once or twice a week. The grates, as in usual practice, should be shaken at least once a day, preferably just prior to the checking of the fire for night operation. The ash-drawers may be removed daily, or at less frequent periods, depending upon the rate of consumption of the fuel. On the average it should not be necessary to remove the ash-drawers more than about twice a week.

While an illustrative form of the invention has been described in considerable detail, it will be understood that numerous changes may be made in the construction and arrangement of the various portions of the boiler without departing from the general principles and scope of the invention. Moreover, while the invention has been disclosed in relation to a boiler for the generation of steam or hot water, certain of the features are applicable also to a hot air furnace or heating system or the like. The terms and expressions employed herein should be understood to be terms of description and not of limitation.

What I claim is:

1. A heating unit comprising a combustion chamber, a grate at the bottom of said chamber, an enclosed compartment beneath said grate constantly open to the atmosphere to an extent sufficient to allow the flow of air required to adequately support combustion at the maximum rate desired, draft-producing means, constantly open communications between said draft-producing means and said combustion chamber, connections between said draft-producing means and said compartment, and means for partly or substantially completely closing off said connections as desired.

2. A heating unit comprising a combustion chamber, a grate at the bottom of said chamber, an enclosed compartment beneath said grate, the walls of said compartment being provided with permanent openings for the constant admission of air thereto beneath said grate, said openings being large enough to allow the flow of air required to adequate support combustion at the maximum rate desired, draft-producing means, constantly open communications between said draft-producing means and said combustion chamber, connections between said draft-producing means and said compartment, and means for partly or substantially completely closing off said connections as desired.

3. A heating unit comprising a combustion chamber, a grate at the bottom of said chamber, an enclosed compartment beneath said grate in constant and invariable communication with the atmosphere to an extent sufficient to allow the flow of air required to adequately support combustion at the maximum rate desired, a chamber in open communication with said combustion chamber and communicating also with said compartment, a damper for regulating the extent of communication between said chamber and said compartment, and draft-prducing means connected with said chamber.

4. A heating unit comprising a combustion chamber, a grate at the bottom of said combustion chamber, an ash-pit beneath said grate constantly open to the atmosphere to an extent sufficient to allow the flow of air required to adequately support combustion at the maximum rate desired, a secondary combustion chamber, a flue-gas header, constantly open tubes connecting said first-mentioned combustion chamber, said secondary combustion chamber and said header, a passage between said header and said ash-pit, means for variably closing said passage, and draft-producing means constantly drawing upon said header.

5. A method of regulating the draft in a heating or steam-generating apparatus having a combustion chamber and a grate at the bottom of said chamber and adapted to utilize solid fuel which comprises maintaining the combustion chamber in continuous open communication with a chimney, causing the chimney to draw air from beneath the grate, maintaining the space beneath the grate in constant and invariable communication with the atmosphere to an extent sufficient to allow the flow of air required to adequately support combustion at the maximum rate desired, and varying the rate of combustion by regulating the withdrawal of air from beneath the grate.

ANDREW DRUMMOND.