April 20, 1948. F. B. GAMBLIN 2,439,972

HOT AIR HEATER WITH SELECTIVE INDIRECT DRAFT

Filed Oct. 19, 1944 4 Sheets-Sheet 1

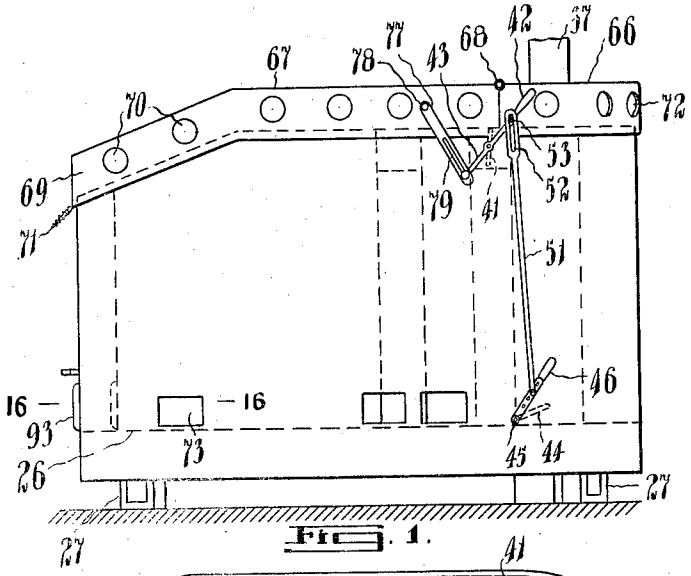


Fig. 1.

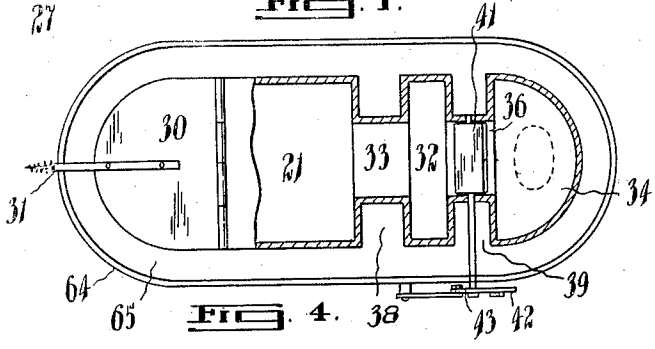


Fig. 4.

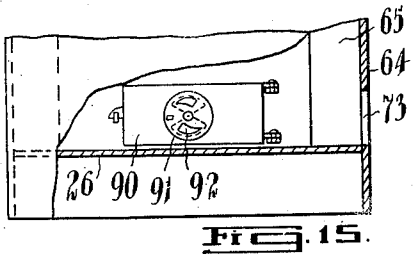


Fig. 15.

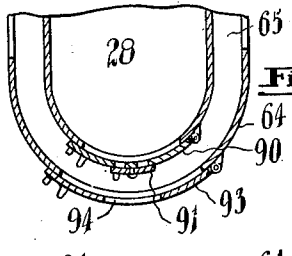


Fig. 16.

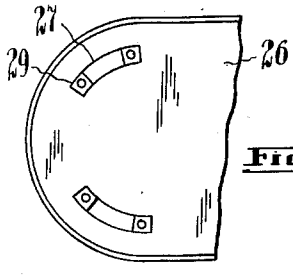


Fig. 10.

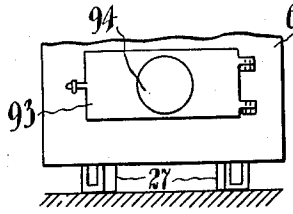


Fig. 17.

Inventor
F. B. Gamblin
by Frederick C. Bromley
Attr.

April 20, 1948. F. B. GAMBLIN 2,439,972

HOT AIR HEATER WITH SELECTIVE INDIRECT DRAFT

Filed Oct. 19, 1944 4 Sheets-Sheet 2

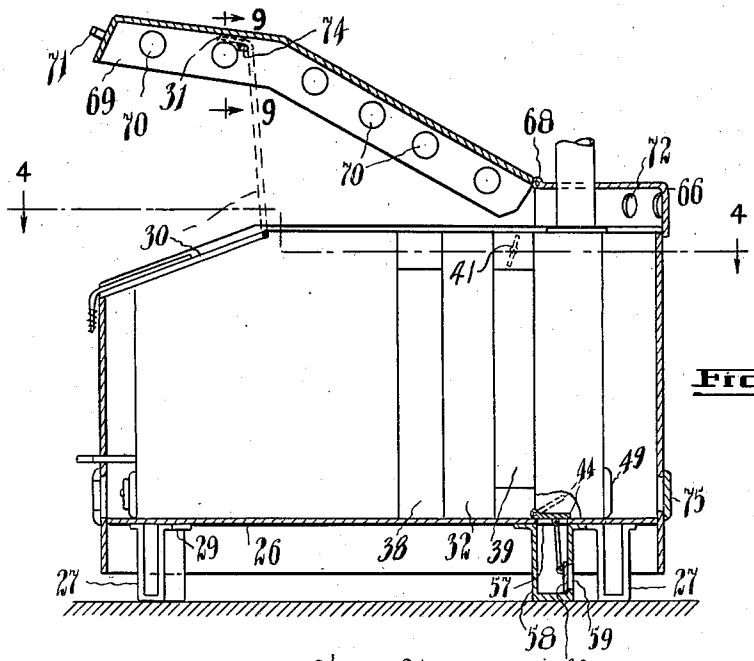


Fig. 2.

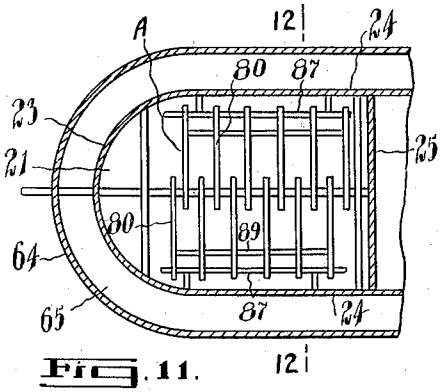


Fig. 11.

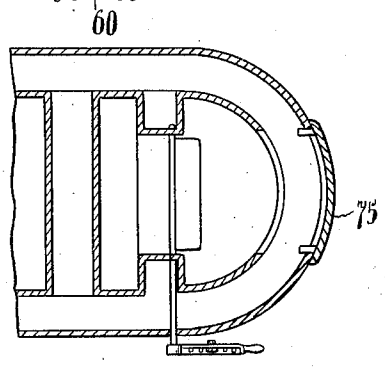


Fig. 5.

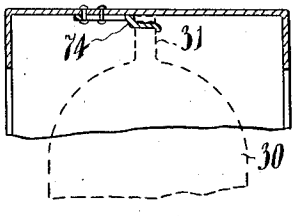


Fig. 9.

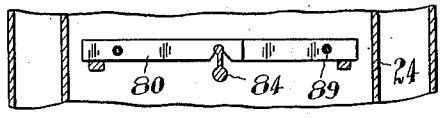


Fig. 12.

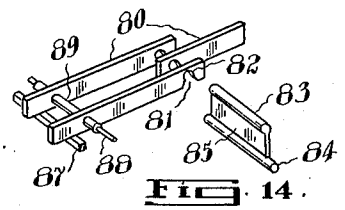


Fig. 13.

Fig. 14.

Inventor
F. B. Gamblin
By Frederick C. Bromley
Atty

April 20, 1948. F. B. GAMBLIN 2,439,972

HOT AIR HEATER WITH SELECTIVE INDIRECT DRAFT

Filed Oct. 19, 1944 4 Sheets-Sheet 3

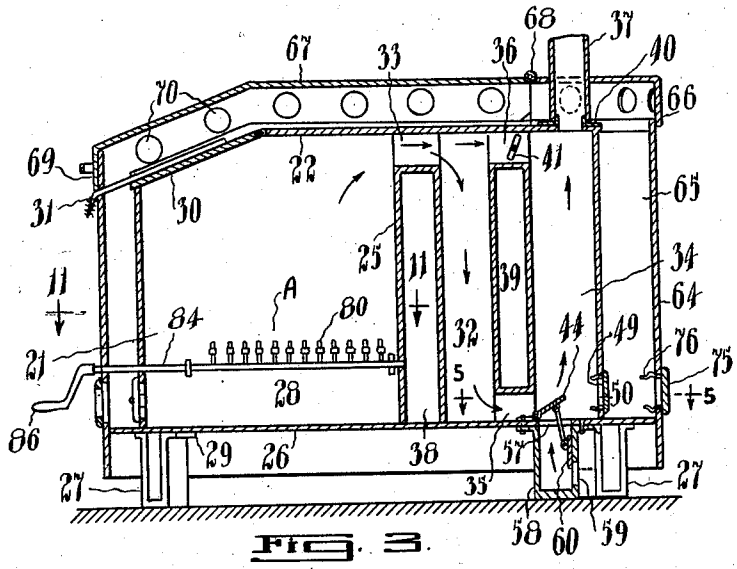


Fig. 3.

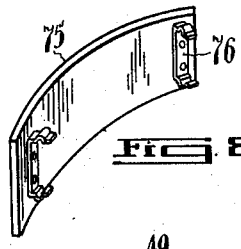


Fig. 8.

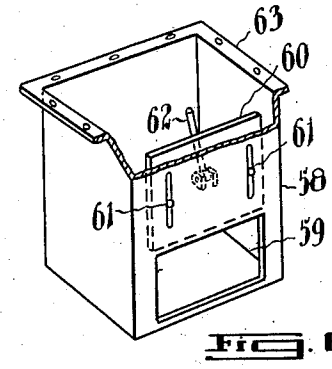


Fig. 6.

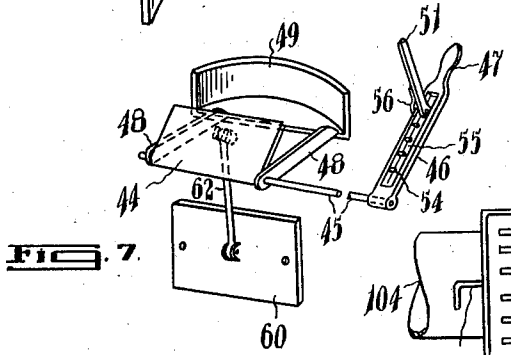


Fig. 7.

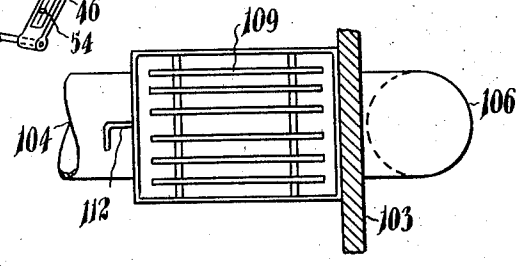


Fig. 19.

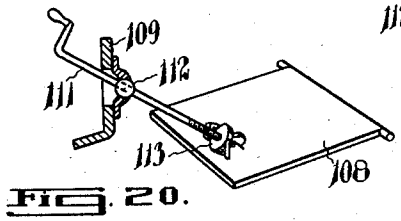


Fig. 20.

Inventor
F. B. Gamblin
By Frederick E. Bramley
ATTY.

April 20, 1948. F. B. GAMBLIN 2,439,972

HOT AIR HEATER WITH SELECTIVE INDIRECT DRAFT

Filed Oct. 19, 1944 4 Sheets-Sheet 4

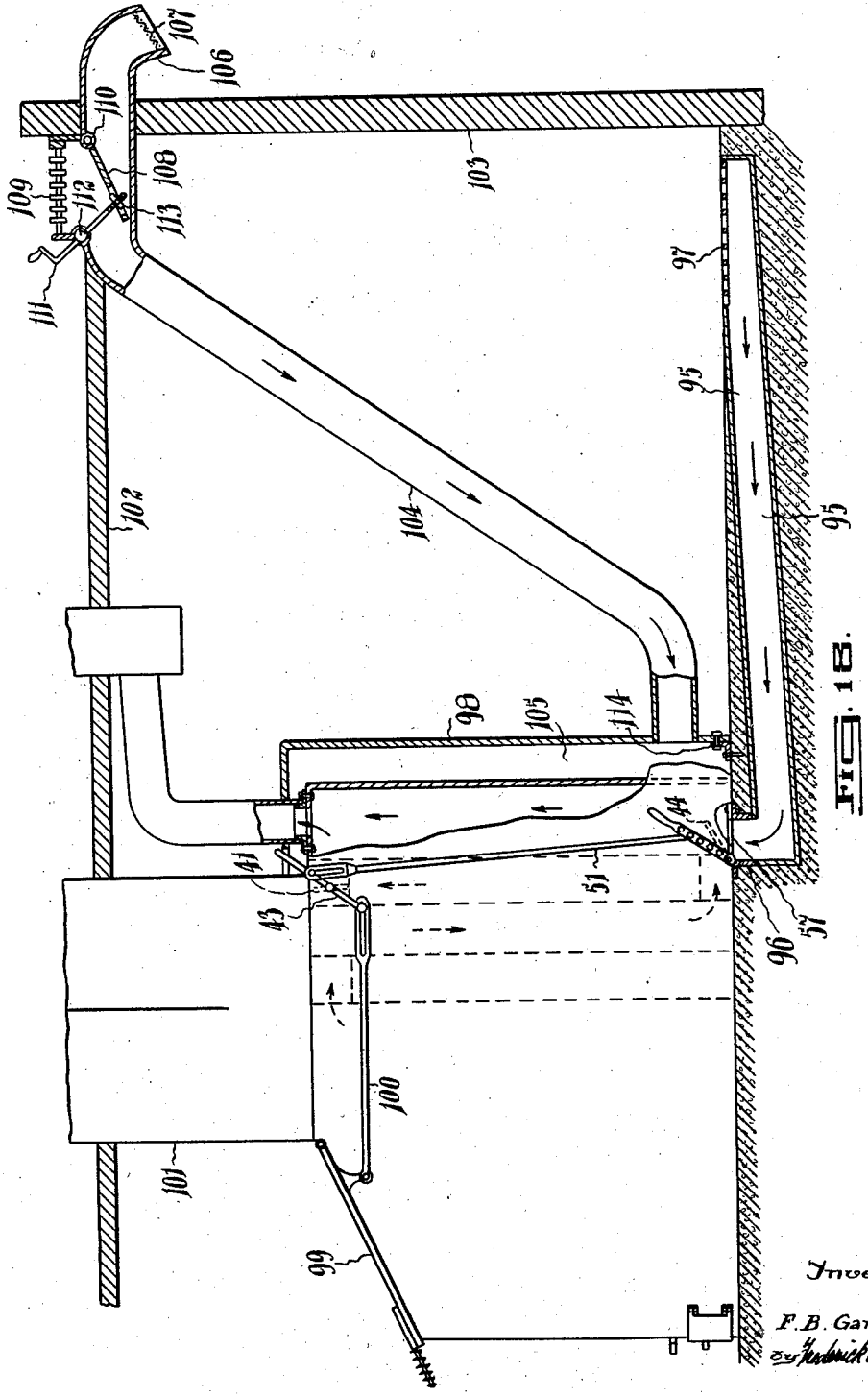


FIG. 18.

Inventor
F. B. Gamblin
by Frederick E. Bramley
ATTY.

Patented Apr. 20, 1948 2,439,972

UNITED STATES PATENT OFFICE

2,439,972

HOT-AIR HEATER WITH SELECTIVE INDIRECT DRAFT

Fay B. Gamblin, Smithers, British Columbia, Canada

Application October 19, 1944, Serial No. 559,394

10 Claims. (Cl. 126—67)

1

My invention relates to improvements in heating systems of the kind comprising stoves and furnaces in which air is heated and distributed therefrom by convection.

The primary object of the invention is to provide a highly efficient and economical heating plant for general useage, and one which will supply a more satisfactory circulation of warmed or hot air for heating one or more rooms of a building.

A further object of the invention is to provide a heating system that can be readily controlled, and one which has flexibility of heat regulation.

A still further object of the invention is to supply a heating system in which foul air is drawn off a room and replaced by fresh air heated to a desirable temperature.

Having described the major object of the invention, subsidiary objects and advantages will appear as the invention is fully described in the following specification of which the accompanying drawings form a part.

In the drawings,

Fig. 1 is a side elevation of the invention as a stove.

Fig. 2 is a longitudinal section thereof through the casing of the radiator. In this view a hinged cowling of a casing is shown raised to permit access to the firebox lid for fueling purposes.

Fig. 3 is a vertical section through the stove but showing the cowling lowered, as in Fig. 1.

Fig. 4 is a section taken on line 4—4 of Fig. 2.

Fig. 5 is a section on line 5—5 of Fig. 3.

Fig. 6 is a perspective detail of the ventilator by which foul air is drawn off a room from the floor line.

Fig. 7 is a detail of the combined damper and deflector which is connected in tandem to a slide plate in the ventilator.

Fig. 8 is a detail of the clean-out door at the back of the stove.

Fig. 9 is a cross section of the cowling taken on line 9—9 of Fig. 2 and depicting a device for securing it in a raised position.

Fig. 10 is a fractional bottom plan of the stove showing the feet upon which it stands.

Fig. 11 is a sectional plan taken on line 11—11 of Fig. 3 illustrating the grate construction in the firebox.

Fig. 12 is a cross section on line 12—12 of Fig. 11 showing the arrangement of the shaker bars of the grate.

Fig. 13 is a perspective detail of the shaker bars of the grate.

2

Fig. 14 is a perspective detail of the rocker bar of the grate.

Fig. 15 is a fractional front view of the stove depicting the casing broken away to show the ash pit door to better advantage.

Fig. 16 is a fractional section on line 16—16 of Fig. 1 showing the ash-pit door and the outside door in the casing that surrounds the fire box.

Fig. 17 is a front view of the lower portion of the stove depicting the outside door that renders the ash-pit door accessible.

Fig. 18 is a general schematic view of the invention as a furnace, which is shown located in a basement of a building with a duct for drawing in fresh air and a duct for drawing off foul air.

Fig. 19 is a plan view of the register in the fresh air inlet pipe shown in Fig. 18.

Fig. 20 is a perspective detail of the directional damper shown below the register in the fresh air pipe of Fig. 18.

Like numerals of reference denote similar parts in each figure of the drawings.

In describing my heating plant I shall at first refer to Figs. 1 to 17 inclusive in which there is shown a heater of the stove type. The heater comprises a firebox 21, the upper part of which forms a combustion chamber defined in part by the top wall 22. The front wall of the firebox is preferably rounded as at 23 and merged into the parallel side walls 24 which extend to the rear wall 25. The grate is denoted as a whole by the character A.

The upright walls of the firebox are integral with or secured to a base or bottom wall 26 which extends outwardly and rearwardly thereof, as shown, and is supported upon legs 27. The grate A is disposed above the bottom wall 26 to provide an ash pit 28. The legs, four in number, are shown as U-shaped members having lugs 29 extending outwardly from the upper ends by which they are bolted to the bottom wall 26. The legs are curved in plan to conform to the curvature of the ends of said bottom wall as will best be seen from an inspection of Fig. 10.

The front end of the top of the firebox is provided with a feed door 30 for fueling purposes, which is in the form of a lid hinged at its rear to swing upwardly. I arrange the lid to slope forwardly in its closed position so that when raised it will facilitate replenishing of fuel, especially comparatively long pieces of wood which can be easily inserted in the sloping opening uncovered by the lid. The lid is supplied with a

forwardly projecting handle 31 which terminates in a grip portion fashioned of coiled wire as is common to the art.

An important feature of construction of the heater resides in the novel arrangement of a radiator for heating air by means of the products of combustion. The structure comprises a first vertical tube 32 at the rear of the firebox and communicating therewith at the top thereof by means of a duct 33, and a second vertical tube 34 communicating with said first tube by a bottom duct 35 and a top duct 36. These tubes are heat exchangers through which the gases may be diverted in their passage to the smoke pipe 37 which leads off the top of the second tube 34. In the diverted travel of said gases they flow downwardly through the first tube and upwardly through the second tube as indicated by the arrows in Fig. 3. The first tube is spaced from the firebox to provide an intervening passage 38 for circulation of air, and the second tube is spaced to similarly provide an air passage 39. The ends of the tubes are closed off by prolongations of the walls 22 and 26 of the firebox save for the connection of the smoke pipe, for which purpose the top wall extension is supplied with a flanged collar 40 riveted thereto to seat the lowermost length of stove piping.

The duct 36 is supplied with a butterfly damper 41 mounted on a horizontal axis which extends outwardly to one side of the heater and is fitted with a lever having arms 42 and 43. The arm 42 terminates in a grip member suitable for hand operation of the lever. The arm 43 forms a part of a mechanical device for actuating the lever, which will be described later. The damper regulates the flow of gases through the duct 36 and in its fully open position the gases wholly travel directly to the smoke pipe. In the closed position of the damper the gases are diverted downwardly through the tube 32 to the duct 35 thence upwardly through the tube 34 to the smoke pipe. Accordingly the air surrounding the tubes is heated thereby.

At the lower end of the tube 34 I provide a combined damper and deflector 44 hingedly disposed at the outlet side of the duct 35 by means of a shaft 45 controlled by a lever 46 terminating in a handgrip 47 for manual operation. The combined damper and deflector serves to divert gases upwardly from the duct 35 and also acts as a check and mixing plate as will later be explained. Desirably its shaft 45 is journalled in arms 48 carried by a cover plate 49 of a clean-out opening 50 in the tube 34. The arrangement is such that the combined damper and deflector is removable as a unit with the cover plate 49 so that the radiator tubes may more easily be cleaned of soot, etc.

The combined damper and deflector and the cover plate 49 are detailed in Fig. 7. The lever 46 is connected by a tandem rod 51 to the lever-arm 42 aforesaid. The upper end of the tandem rod has a slot 52 in which a pin 53 on the arm 42 is free to slide so as to provide an attachment by which lost motion takes place in one direction of movement. By this tandem rod connection the combined damper and deflector 44 will be automatically raised to an open deflecting position—as shown in Fig. 3—should it not previously have been set in such position. As will best be seen from an inspection of Fig. 7, the lower end of the tandem rod is attached to the lever 46 by a device that permits of adjustment of the throw. This consists of a lengthwise series of pins 54 within a radial slot 55. A hole is provided in the tandem rod for selective engagement with any one of these pins that gives the desired throw and the engagement is maintained as by a leaf spring 56. According to this construction it will be manifest that by lengthening the radius of operation of the lower end of the tandem rod a shorter throw will be communicated to the check damper 44 in closing the upper damper 41 with the result that the room temperature will be increased.

The check damper 44 controls a port 57 in the bottom wall 26, which is encased by a ventilator 58 in the form of a box, detailed in Fig. 6, which depends to the floor of the room. One of the sides of the ventilator is apertured at the bottom to furnish a port 59 for admission of foul air drawn off the room. The air thus inducted mixes with the gases and is conducted through the tube 34 to the smoke pipe. The port 59 is controlled by a slide plate or shutter 60 vertically guided as by a pin and slot connection indicated at 61. The slide plate is actuated by a tandem rod or link 62 which is pivoted thereto at one end and likewise connected at its other end to the damper 4—4. By this arrangement the slide plate is automatically controlled by the check damper 44, and it will be gathered that when this damper is thrown to a horizontal position in which it closes the port 57 the port 59 is closed concurrently by the slide plate. The ventilating device is an important feature of the invention in that it functions to exhaust from a room the cold foul air at floor level when the port 59 is opened. The ventilator should be disposed immediately adjacent to the floor to secure best results and for this reason it is proposed that in the manufacture of the heater the ventilator shall be made in different depths so that one of the required depth may be used according to whether or not a floor mat is employed. To this end the ventilator is detachably connected to the wall 26 as by bolting its flange 63 thereto, which renders it interchangeable.

The firebox 21 and the heat exchanger tubes 32 and 34 at the rear thereof are encompassed by a casing 64 which is spaced therefrom to provide an air chamber 65 that also extends above the top wall 22. The casing is closed by a hood 66 substantially formed by a cowling 67 extending forwardly from a point near the rear where it is hinged as at 68 to swing upwardly so that it may be raised as shown in Fig. 2 to gain access to the lid 30. The cowling has a side flange 69 fitting around the wall of the casing, which is apertured at intervals as at 70. A handle 71 is carried at the front for raising the cowling. The hood is likewise apertured as at 72. The casing is attached to the bottom wall 26 in suitable manner and otherwise supported as circumstances of manufacture dictate. Apertures as at 73 are supplied in the sides of the casing immediately above the bottom wall 26 to constitute cold air inlets, the air admitted thereby being heated by the firebox and the heat exchanger to the rear thereof and rising to the outlet apertures 70 and 72 for circulation about the room. This construction provides a maximum of hot air circulation and an optimum of heating efficiency.

The cowling will carry a suitable catch 74—best shown in Fig. 9—by which the lid 30 may be held in an open position when the cowling is raised. This enables the person tending the

stove to use both hands in order to lay large pieces of wood on the fire in orderly manner in replenishing the fuel. The catch may be of a form to slide transversely back and forth of the handle 31 to engage and disengage the same. A clean-out door 75 will be provided in the back of the casing in register with the clean-out plate 49 aforesaid for access thereto. This door may be held in place by spring catches 76 riveted in place—best discernible in Fig. 8.

The cowling 37 is furnished with a mechanical connection to the damper 41 so that as it is raised it will open this damper automatically to draw up the fire or to permit residual smoke to pass directly to the smoke pipe 37 at the time of refueling. The mechanical connection consists of a link 77 pivoted at 78 to a side of the cowling and provided with a lengthwise slot 79 in which the lever arm 43 is slidably pinned. The slot 79 enables the lever to operate independently of the raising of the cowling in the use of the handle arm 42.

Now, referring back to the grate A this is of a novel construction comprising two sets of transverse shaker bars as at 80, having their inner ends interfitted in staggered formation and notched inwardly of their bottom faces as at 81. The notches are substantially V-shaped and each is enlarged circularly at its vertex as at 82 to receive a rounded key member 83 of a rocker bar 84. The key member loosely engages the said notches and is integrated with the rocker rod or bar by a web 85. Bar 84 is turnably mounted in the firebox and projects forwardly through the casing 64 to receive a detachable shaker crank 86. The outer ends of said shaker bars 80 rest upon benches 87 and are free to slide endwise. The shaker bars of each set are rigidly united in spaced relation by a tie rod 88 carrying distance pieces 89 by which the shaker bars are spaced. The shaker bars reciprocate when the rocker bar 84 is oscillated by the crank, the movement being limited by the angle of the V-shaped notches 81 to about a quarter turn. This shaker action is smooth and operates to thoroughly sift out ashes without unduly disturbing the fire.

The ash pit 23 is fitted with a swing door 90 at the front of the firebox which is curved in conformity to the curvature thereof. This door has draft induction slots controlled by a rotary shutter 91 centrally pivoted and supplied with a knob by which it can be manually turned. Said rotary shutter is constructed with tapering slots 92 for co-acting with the said induction slots of the door. The taper of the slots 92 enables a fine adjustment to be had in regulating the draft, which is necessary on account of the highly efficient heating apparatus of the invention. A door 93 in the front of the casing 64 renders the ash pit door accessible and is provided with a circular hand hole 94 by which access may be had to the rotary shutter without the necessity of opening the door 93 in regulating the draft.

Now, adverting to Fig. 18 it will be seen that I have herein shown an embodiment of my invention as a hot air furnace, the construction within the casing of which is the same as that above recounted, except that the ventilator is dispensed with and in its place there is provided a pipe 95 for foul air. This pipe is sunk in the foundation upon which the furnace rests and has an elbow connection 96 with the base of the furnace in register with the port 57 which is controlled by the combined damper and deflector 44 aforesaid. This pipe slopes upwardly and outwardly from the furnace to the floor and at floor level is provided with a register 97 for admitting foul air drawn off the room and mixed with the products of combustion for conduction to the smoke pipe.

A further variation of the furnace structure is that the casing, indicated at 98, does not have a cowling over the firebox lid, denoted at 99. The lid 99 is exposed and connected by a slotted link 100 to the arm 43 for operating the damper 41 in the manner described in connection with the link 77 aforesaid. The casing is supplied with hot air piping 101 for delivery of heated air to rooms above the basement in which the furnace is installed; the floor above the basement being indicated at 102 and one of the outside walls of the building being shown at 103.

As a further feature of the furnace structure the casing thereof is provided with a pipe 104 communicating with the radiator chamber 105 near the base and extending upwardly to the ceiling and outwardly through the wall 103 where it terminates in a downturned elbow 106 suitably screened as at 107. Pipe 104 serves for the induction of fresh air into the heating compartment of the furnace and the ingress is controlled by a direction damper 108. Above this damper the pipe is supplied with a register 109 which is disposed within the building and raised above the floor 102. This register may have a grating formed of slats united by tie rods and removably supported.

The directional damper 108 is a plate hinged at 110 to swing transversely beneath the register 109 in a manner to open and close the same and also to open and close the fresh air inlet. The directional damper is actuated by a reach screw 111 having a ball and socket joint 112 by which it is supported for swivel movement. The outer end has a crank or other device by which it can be turned. The inner end has screw-threaded engagement with a gimbal ring 113 mounted in the free end of the direction damper by means of trunnions by which the requisite compound movement is secured in conjunction with the joint 111—see particularly Figs. 19 and 20.

In the manufacture of my heating plant it is proposed that the furnace casing shall be interchangeable with that of the stove. The casing may be bolted to the unit base or frame by angle clips as illustrated at 114 in Fig. 18.

From the preceding description it will be manifest that I have set forth a highly efficient and economical heating apparatus of the hot air type and one which is adapted for various uses and can be modified according to the purpose for which it is intended.

It will be understood that such changes and variations in construction of the structure as set out in this specification may be resorted to as come within the subjoined claims.

What I claim is:

1. In a heating apparatus of the kind described, a firebox, a series of vertical tubes at a side thereof, said tubes closed at their ends and spaced to provide intervening passages for circulation of heated air, a smoke pipe communicating with the upper part of the end tube of the series, upper and lower horizontal ducts forming communications between the firebox and the tubes whereby products of combustion may either pass directly to the smoke pipe or downwardly through one tube and upwardly through the next,

a horizontal damper in one of the upper ducts between adjacent tubes, a combined damper and deflector plate disposed in the bottom part of the end tube of the series for controlling a port provided in the bottom thereof, the combined damper and deflector plate being hingedly mounted at an edge of said port adjacent to the lower duct of the said end tube for directing the products of combustion upwardly of said port when opened, means for conducting foul air to said port, and a case encompassing said series of vertical tubes and forming a wall part of said passages for circulation of heated air, said case having inlet and outlet openings.

2. In a heating apparatus of the kind described a firebox, a radiator for utilizing the products of combustion therefrom, said radiator comprising a first vertical tube and a second vertical tube at the rear of the firebox having a port in its bottom, the tubes being closed at their ends, a first duct forming a communication between the upper part of the firebox and the upper end of the first vertical tube, a second duct forming a communication between the upper ends of said tubes, a third duct forming a communication between the lower ends of said tubes, a damper horizontally disposed in said second duct, a deflector horizontally arranged within the bottom portion of said second tube and disposed over said port for controlling the same and having an edge hinged adjacent to said third duct whereby it is upwardly swingable to open the port and at the same time to divert products of combustion from the third duct over and upwardly of the port, means for controlling said dampers, a smoke pipe leading off the upper end of said second tube, and a casing enclosing said tubes and providing a chamber for heated air having inlet and outlet openings.

3. In a heating apparatus of the kind described, a firebox, a series of vertical tubes at a side thereof, said tubes closed at their ends and spaced to provide intervening passages for circulation of heated air, a smoke pipe communicating with the upper part of the end tube of the series, upper and lower horizontal ducts forming communications between the firebox and the tubes whereby products of combustion may either pass directly to the smoke pipe or downwardly through one tube and upwardly through the next, a horizontal damper in one of the upper ducts between adjacent tubes, a combined damper and deflector plate disposed in the bottom part of the end tube of the series for controlling a port provided in the bottom thereof, the combined damper and deflector plate being hingedly mounted at an edge of said port adjacent to the lower duct of the said end tube for directing the products of combustion upwardly of said port when opened, a ventilator housing below said end tube of the series adapted to surround the said port and having an opening for drawing off foul air from a room.

4. A structure as set forth in claim 1, in which means are provided on said case to support the series of tubes in elevated position with respect to the supporting surface of the room in which the heating apparatus is installed, and in which a ventilator duct encloses the port in the end tube of the series and depends to said supporting surface and has an opening at its bottom for admittance of air.

5. A structure as set forth in claim 1, in which means are provided on said case to support the series of tubes in elevated position with respect

to the supporting surface of the room in which the heating apparatus is installed, and in which said means for conducting foul air to said port includes a sloping pipe extending to a register in said supporting surface.

6. A structure as defined in claim 2, in which a ventilator duct depends from the second vertical tube and encases the inlet side of the port therein and has an opening in a wall portion, and in which a slide plate controls said opening and is actuated by the deflector.

7. A structure as defined in claim 2, in which an apertured ventilator duct depends from the second vertical tube to enclose the inlet side of the port therein, and in which the aperture of the ventilator is controlled by a slide plate connected by a tandem rod to the deflector.

8. In a heating apparatus of the kind described, a firebox, a series of vertical tubes at a side thereof, said tubes closed at their ends and spaced to provide intervening passages for circulation of heated air, a smokepipe communicating with the upper part of the end tube of the series, upper and lower horizontal ducts forming communications between the firebox and the tubes whereby products of combustion may either pass directly to the smoke pipe or downwardly through one tube and upwardly through the next, a horizontal damper in one of the uper ducts between adjacent tubes, a combined damper and deflector plate disposed in the bottom part of the end tube of the series for controlling a port provided in the bottom thereof, the combined damper and deflector plate being hingedly mounted at an edge of said port adjacent to the lower duct of the said end tube for directing the products of combustion upwardly of said port when opened, a mechanical connection between said damper and the said combined damper and deflector plate whereby in the opening movement of the combined damper and deflector plate the said damper is moved toward a closed position, and lost motion means whereby either is operable independently of the other, means for conducting foul air to said port, and a case encompassing said series of vertical tubes and forming a wall part of said passages for circulation of heated air, said case having inlet and outlet openings.

9. In a heating apparatus of the kind described, a firebox, a series of vertical tubes at a side thereof, said tubes closed at their ends and spaced to provide intervening passages for circulation of heated air, a smoke pipe communicating with the upper part of the end tube of the series, upper and lower horizontal ducts forming communications between the firebox and the tubes whereby products of combustion may pass either directly to the smoke pipe or downwardly through one tube and upwardly through the next, a horizontal damper in one of the upper ducts between adjacent tubes, a combined damper and deflector plate disposed in the bottom part of the end tube of the series for controlling a port provided in the bottom thereof, the combined damper and deflector plate being hingedly mounted at an edge of said port adjacent to the lower duct of the said end tube for directing the products of combustion upwardly of said port when opened, a device connecting said damper to said combined damper and deflector plate for translating a movement of one to the other and including a lever and rod connection having a lost motion means so that one may be actuated independently of the other, and a case encompassing said series of vertical tubes and forming a wall part of said

passages for convection circulation of heated air, said case having inlet and outlet openings.

10. A heating apparatus as defined in claim 8, in which said mechanical connection comprises hand levers respectively carried by said damper and said combined damper and deflector plate, and a rod connected to said levers, the connection of said rod to one of the levers including a longitudinal series of pins for selective engagement with a hole in said rod and spring means for retaining said engagement, the arrangement being operable to vary the throw of one damper relative to the other; and in which said lost motion means comprises a pin and slot connection between said rod and the other of the levers such that this lever may be shifted in one direction independently of the other lever.

FAY B. GAMBLIN.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
305,940	Lewis	Sept. 30, 1884
356,980	Boynton	Feb. 1, 1887
580,691	Hedges	Aug. 13, 1897
611,359	Dickson	Sept. 27, 1898
881,960	Rolin	Mar. 17, 1908
1,549,893	Sanford	Aug. 18, 1925
1,658,971	Cook	Feb. 14, 1928
2,174,347	Card	Sept. 26, 1939
2,296,545	Tichbourne	Sept. 22, 1942
2,348,569	Peters	May 9, 1944
2,348,933	Seeley	May 16, 1944