

Sept. 10, 1946.

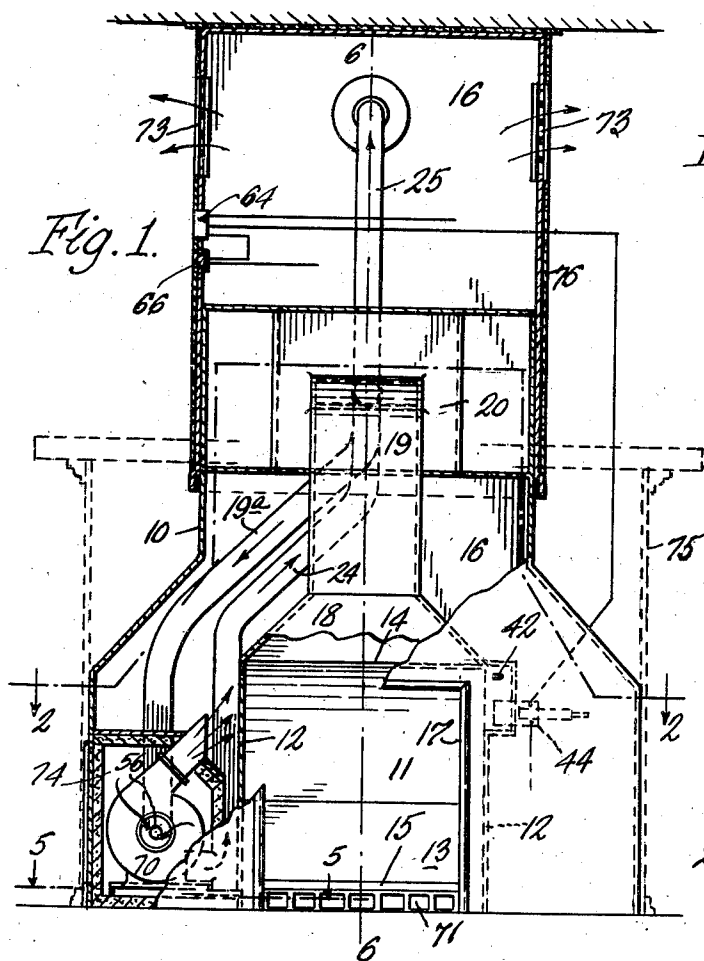
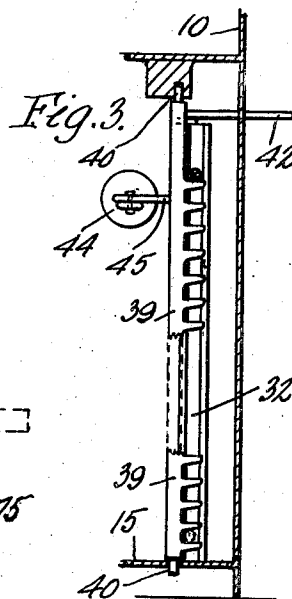
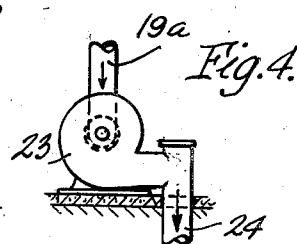
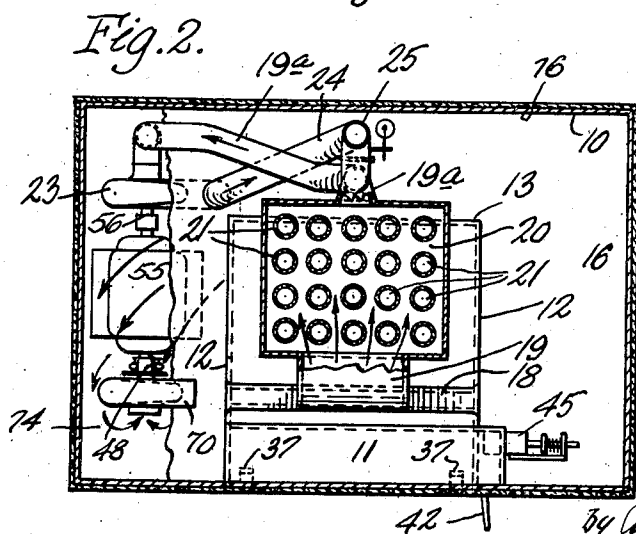
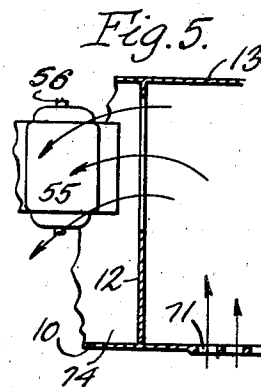
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2,407,590

HEATING APPARATUS

Filed Jan. 23, 1943

3 Sheets-Sheet 1



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HEATING APPARATUS

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3 Sheets-Sheet 2

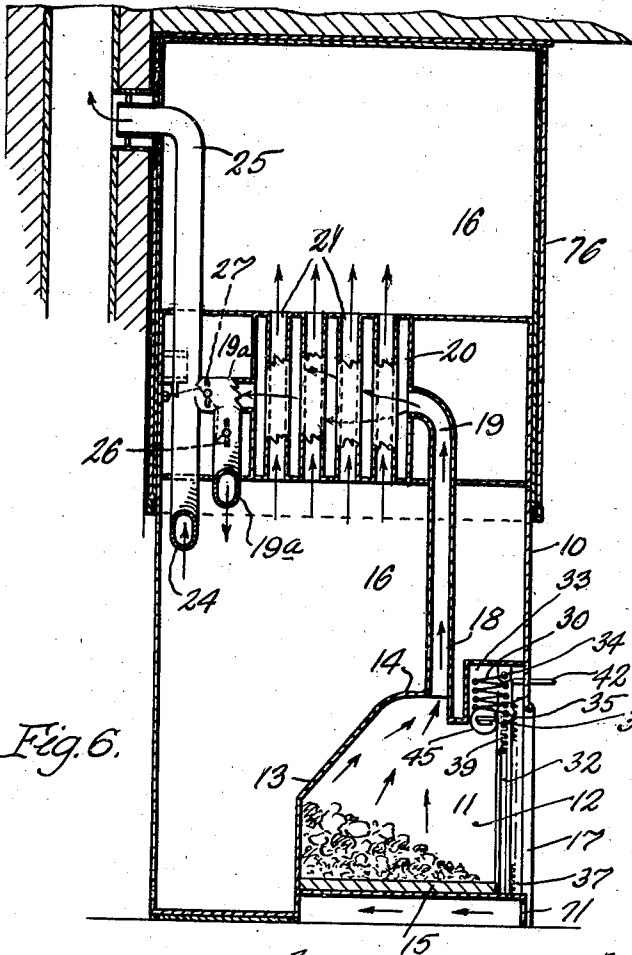


Fig. 6.

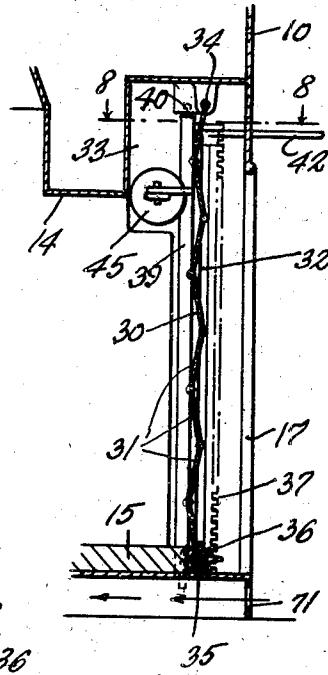


Fig. 7.



Fig. 8.

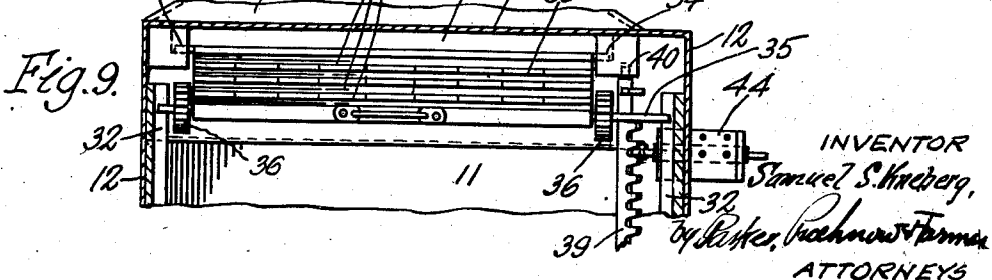


Fig. 9.

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Fig. 10.

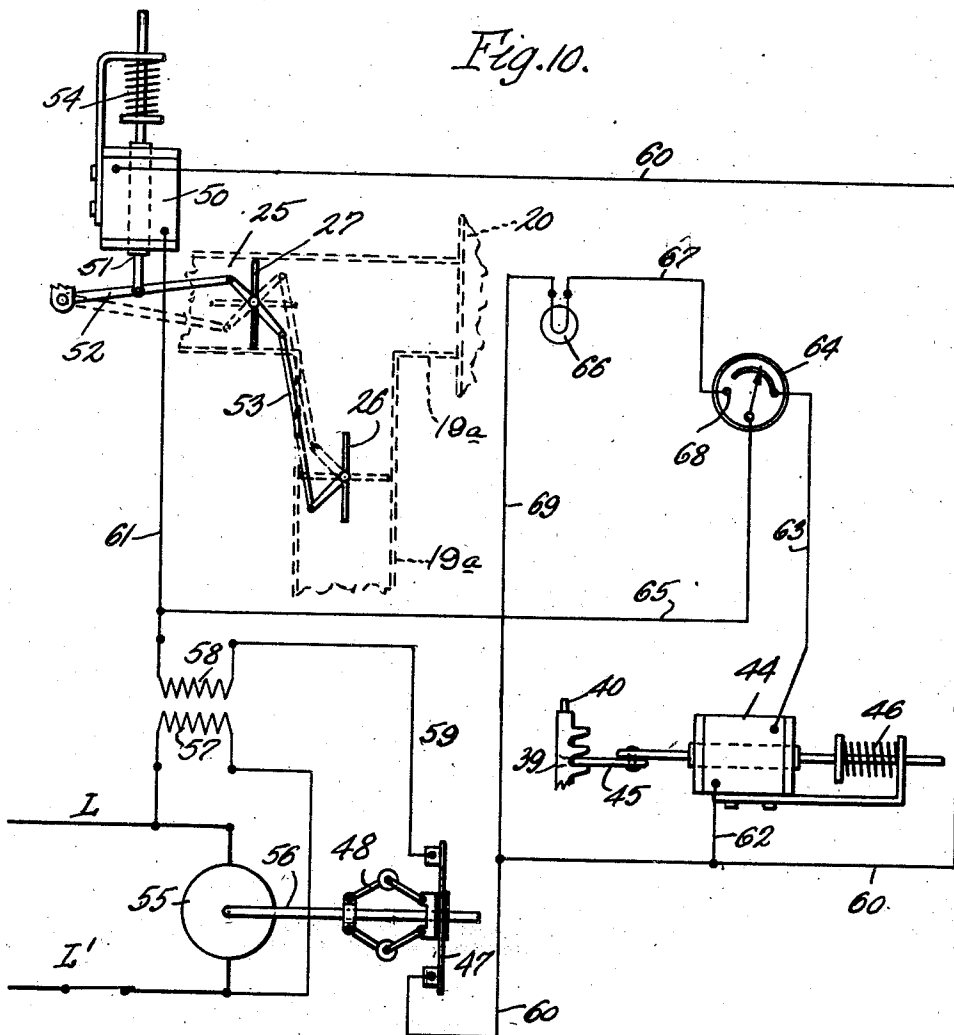


Fig. 11.

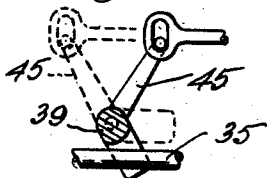
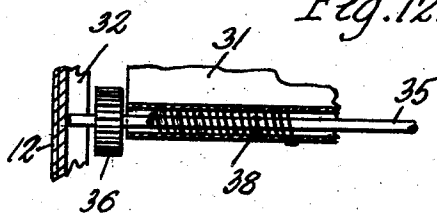


Fig. 12.



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UNITED STATES PATENT OFFICE

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HEATING APPARATUS

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Application January 23, 1943, Serial No. 473,350

6 Claims. (Cl. 126-140)

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This invention relates to heating apparatus for houses, and has for one object to provide a desirable, efficient and economical heater in which wood or other fuel can be burned in an open fire, as in an ordinary open fireplace, but which obviates the necessity for the usual expensive, built-in masonry fireplace and chimney.

Other objects of the invention are to produce a heater with an open front in which an open fire can be built and operated and which is equipped with safety means that automatically close in the fire and provide for smoke removal upon failure or reduction of the draft below a normal operating condition, to prevent smoking or the escape of products of combustion into the house; which is provided with a smoke pipe of small dimensions in which a forced draft for the fire is created, whereby the apparatus can be installed and operated at moderate expense in a house that is not equipped with a chimney, such as ordinarily required for an open fireplace; which is adapted for use against an inner partition wall or other wall of a house where there is no chimney flue; which is provided with safety means which will automatically check the fire if too hot, and prevent the escape of smoke into the house, whereby the fire can be safely left burning without the presence of anyone in the house to attend the fire and the fire hazard of many fireplaces is eliminated; which is provided with a smoke pipe having main and safety branches and means whereby, in the normal operation of the heater, a forced draft is created in the main branch pipe, whereas upon failure in the normal operation of the forced draft, the open front of the heater is closed and the safety branch pipe is opened for the escape of the products of combustion and the heater is prevented from smoking; also to provide a portable fireplace which can be installed in any desired place in a house and affords the pleasures of an open wood fire burning in the usual open fireplace; which simulates and operates like the usual open fireplace; which can be closed and operated like a stove; which can be adapted to fit in and operate in an ordinary fireplace opening; which is designed to draw cold air from the room and heat it and return the heated air into the room or house; which can be utilized in conjunction with an existing fireplace to improve its heating efficiency and prevent its smoking due to faulty fireplace or flue design; and which reduces first cost of installation in new or old houses, and ensures economical and satisfactory operation regardless of the height of the house chimney.

With the above and other objects and advantages in view, which will hereinafter appear, preferred embodiments of my invention, disclosed in the accompanying drawings, are hereinafter described and the novel features of the invention are set forth in the appended claims.

In said drawings:

Fig. 1 is a front elevation, partly in vertical section, of a heater embodying my invention.

Fig. 2 is a sectional plan view thereof, taken approximately on the line 2-2, Fig. 1.

Fig. 3 is a fragmentary, transverse, vertical section of the heater, on line 3-3, Fig. 8, showing the means for releasably holding the front gate or shutter for the fireplace in different open positions.

Fig. 4 is a fragmentary, sectional elevation showing an alternative arrangement of the smoke discharge flue or pipe.

Fig. 5 is a fragmentary, sectional plan view on line 5-5, Fig. 1, showing the cold air intake.

Fig. 6 is a central vertical section of the heater on line 6-6, Fig. 1.

Fig. 7 is a vertical sectional elevation on line 7-7, Fig. 8.

Fig. 8 is a fragmentary sectional plan view on line 8-8, Fig. 7.

Fig. 9 is a fragmentary vertical sectional elevation on line 9-9, Fig. 8, showing the gate or shutter in open position.

Fig. 10 is a diagram of the electrical control means for the heater.

Fig. 11 is an enlarged fragmentary section showing in full lines the gate-holding means in holding position, and in dotted lines the position of the parts when the gate is released.

Fig. 12 is a fragmentary, vertical section of the lower portion of the gate showing means for urging the gate in a downward or closing direction when released.

The heater comprises an outer metal casing 10 and a metal fire box or chamber 11 which is arranged within the outer casing with the side walls 12, back wall 13, top wall 14, and preferably also the bottom wall 15 of the firebox spaced inwardly from the corresponding walls of the outer casing so as to provide an air space 16 within the outer casing between the walls thereof and the walls of the fire box. The fire box has an open front or large front opening 17 through which air is admitted to support combustion of the wood or other fuel which may be placed through the opening for burning in the fire box. A smoke pipe or flue connects with the fire box preferably by means of a funnel-like mouth portion 18 which

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has a relatively long, narrow inlet opening that extends across the width of the fire box and opens thereinto at its top front portion, said mouth portion tapering to its junction with the smoke pipe. As shown, this smoke pipe is located in the air space 16 within the outer casing 10 and is interrupted by or has interposed between portions 19, 19a thereof (herein designated respectively as inlet and suction portions), a condenser or heat exchanger 20 which may be of any suitable construction adapted to effect exchange of heat between air circulated through the air space 16 and the products of combustion passing through the smoke pipe. The smoke condenser shown comprises a box or chamber which connects at opposite sides with the inlet and suction sections 19, 19a of the smoke pipe and has a plurality of open-ended air tubes 21 extending therethrough from top to bottom for the passage of air from the air space 16 upwardly through the tubes, so that the products of combustion will pass around the tubes 21 and there will be an exchange of heat between the air and the products of combustion with the result of cooling and condensing the latter and heating the air.

The smoke pipe section 19a leads from the outlet side of the condenser to the suction inlet of a fan or blower 23 which is driven by a motor for creating a forced draft from the fire box through the pipe and discharging the smoke or products of combustion through a discharge section 24 of the pipe, which may be disposed in any suitable manner to discharge the smoke out-of-doors. For instance, this discharge section as shown in Figs. 1 and 6, could lead to a safety section, pipe or flue 25, which ascends from its connection with the main smoke discharge pipe 24 and enters a chimney flue, or may lead out-of-doors through any convenient outer wall of the house; or, as shown in Fig. 4, the discharge pipe 24 can be arranged to pass through the cellar to a distantly located house chimney or other outlet and to discharge the smoke or gases out of doors independently of or without connection with the safety flue 25.

The main smoke pipe and safety branch pipe are controlled by suitable damper or closure means adapted to close the safety branch 25 and open the main suction branch 19a leading to the fan, or to close the latter and open the safety branch. In the construction shown for this purpose, butter-fly dampers 26 and 27 are provided in the main and safety branches of the smoke pipe and may be operated by electrical means under the control of the speed of the fan motor, as hereinafter described, so that in normal operation of the heater, the safety branch 25 will be closed by the damper 27 and the main suction branch opened by the damper 26, so that the smoke or products of combustion will be drawn by the fan through the main suction pipe 19a and discharged out of doors through discharge pipe 24. Whereas, upon failure of the fan motor, or its operation at less than a predetermined minimum speed, the damper 26 will be closed to shut off the pipe to the suction fan, and the damper 27 opened to connect the safety branch pipe or flue with the suction branch 19a, for the escape of the smoke through the safety smoke branch 25.

The heater is also provided with a movable gate or shutter 30 which is operated automatically, as later described, to close the open front or draft opening of the heater for preventing escape of smoke or products of combustion from

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the fire box into the house when the safety branch smoke flue is opened and the draft fan motor fails or the fan is not driven at a sufficient speed to create the necessary forced draft for a normal operation of the heater. As illustrated in the drawings, this gate is composed of a plurality of narrow leaves or sections 31 suitably hinged to each other to fold into a zig-zag or pleated formation for opening the gate and to slide vertically in extended form in suitable guides 32 at opposite sides of the front opening of the heater for closing said opening. The guides 32 connect at their upper ends with a chamber 33 which permits the folding or collapsing of the leaves of the gate when the lower end of the gate is raised to open or uncover the front of the heater. The upper end or leaf of the gate is hingedly fastened as at 34 in the gate chamber 33. Journalled or rotatably mounted on the bottom leaf or lower end portion of the gate is a shaft 35 on the opposite ends of which are fixed gear pinions 36 arranged to mesh with toothed racks 37 stationarily arranged adjacent the gate guides at the opposite sides of the open front of the heater so that when the gate is opened or closed, the rolling of the pinions on the toothed racks will equalize the travel of opposite sides of the gate and prevent possible jamming of the gate in the guides. Preferably a coil spring 38 surrounds the shaft 35 and is connected at one end to the shaft and at the other end to the bottom leaf of the gate, see Fig. 12, in such a manner that when the gate is opened, or its lower end raised manually, the spring will be wound up and will act by its unwinding or spring action to rotate the shaft and pinions in a direction to close the gate, the spring actuated shaft and pinions thus acting to positively move the gate in the closing direction.

The gate is held open, or up against the action of gravity or of its closing spring 38 by a holding device which, as shown, consists of a toothed rack 39 which is movably mounted in the casing at one side of the gate, as by pivots 40 at its opposite ends entering suitable bearings on the casing, whereby the movable rack 39 is adapted to be rocked to engage one or another of its teeth with an adjacent end of the pinion shaft 35. The gate is thus adapted to be held in different adjustments to more or less uncover the open front of the heater by raising or lowering the gate to the desired position and then shifting the toothed rack 39 into engagement with the shaft 35. The gate is released to cause it to drop or close by shifting the rack 39 to disengage it from the shaft. The movable rack is provided with an operating handle or rod 42 which extends out through a hole in the front of the heater casing and is attached at its inner end to an arm on the rack 39, so that the handle can be operated manually for shifting the rack to engage and disengage the shaft 35 for holding or releasing the gate, as may be desired.

Automatic means are also provided which act during normal operation of the heater to retain the gate holding device or rack in position to hold the gate open and which act automatically upon a failure of the fan motor, or a reduction in the speed of the fan below a predetermined minimum speed, to shift the holding device to release the gate to permit it to close. The automatic means as shown comprise a solenoid or electromagnetic device 44, the movable core of which is operatively connected to an arm 45 on the movable rack 39 so that when the solenoid

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is energized, the rack will be held in position to hold the gate open, and when the solenoid is de-energized, a spring 46 acting on an extension of the movable core or element of the solenoid will shift said element and the rack 39 out of engagement with the pinion shaft 35 to release and permit the closing of the gate. The electric device 44 may be connected as hereinafter described, in circuit with a controlling switch 47 actuated by a speed governor 48, diagrammatically illustrated in Fig. 10, which is driven by the fan motor 55. This governor and switch are arranged so that when the fan motor is operating at a desired or normal speed, the governor will hold the switch closed to energize the solenoid, which then acts to hold the gate open, whereas upon failure of the fan motor, or reduction in the speed of the fan below the predetermined minimum speed, the governor will open the switch and thereby de-energize the solenoid, whereupon the spring 46 will actuate the holding device to release the gate, which will be closed by its spring 38.

The damper control means for the safety smoke flue may be operated, like the control or holding device for the safety front gate, by an electromagnetic device or solenoid 50, the core or movable member 51 of which may be connected with the dampers 26 and 27 by suitable lever and link mechanism 52, 53, constructed so as to close the damper 27 of the safety smoke flue 25 and open the damper 26 and the suction pipe 19a when the solenoid is energized, as indicated by the position of the parts in Fig. 10. When the solenoid is de-energized, a suitable spring 54 acting on the solenoid core 51 will, through the lever and link mechanism, reverse the position of the dampers, to close the suction pipe 19a and open the safety branch 25 for the escape of the smoke or products of combustion by natural draft through the safety flue or pipe.

Fig. 10 illustrates diagrammatically suitable electrical connections for operating the solenoids 44 and 50 which control the safety front gate and the smoke pipe damper means. Referring to Fig. 10, 55 represents the electric motor for driving the draft fan 23. The speed governor 48 for actuating the control switch 47 may be connected to and actuated by the motor shaft 56. 51 indicates a transformer which is connected across the main line conductors LL' for the fan motor. One side of the secondary 58 of this transformer is connected by conductor 59, switch 47, conductor 60 to the solenoid 50 which is connected by conductor 61 to the other side of the transformer secondary, and the other solenoid 44 is connected across the transformer secondary by a conductor 62 branching from conductor 60, the winding of solenoid 44, conductor 63, a thermostatic switch 64, conductor 65 and conductor 61. Thus, when the governor switch 47 and thermostatic switch 64 are closed, as shown in Fig. 10, that is, while the heater is operating normally under forced draft, or normal speed of the suction fan, the two solenoids will be energized and the safety front gate 39 will be held open and the safety smoke flue 25 closed. However, upon failure of the electric current or reduction of speed of the fan motor below the predetermined minimum, the speed governor 48 will open the switch 47 and the solenoids will be deenergized, whereby spring 46 of solenoid 44 will rock holding rack 39 to release the gate and permit it to close; and spring 54 of the solenoid 50 will actuate the damper mechanism to close the smoke suction pipe 19a and open the safety smoke flue 25.

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66 indicates a safety signal lamp or device which is connected by a conductor 67 with a contact 68 of the thermostatic switch 64 and by a conductor 69 with the conductor 60 leading to the speed governor switch 47. The circuit of this signal lamp will be maintained open and the lamp extinguished when the speed governor switch 47 is closed and the solenoids 44 and 50 are energized, that is during normal operation of the heater, and during normal travel of the movable arm of the thermostatic switch throughout a desired range of temperature. If, however, the temperature of the heater rises above a safe maximum, the abnormal movement of the movable arm of the thermostatic switch 64 will connect the contact 68 with the conductor 65 and connect the signal lamp across the transformer secondary through the conductors 65 and 69, thus lighting the lamp and indicating the dangerous high temperature of the heater. At the same time this operation of the thermostatic switch 64 will break the circuit through the solenoid 44 and permit the spring 46 thereof to operate the gate-holding rack 39 to cause the closing of the safety gate 30, thereby preventing danger from overheating by the heater.

The heater is also provided with an air circulating fan or blower 70 which is preferably driven by the driving motor 55 for the forced draft fan. This fan may be, as shown, connected with the motor shaft 56 at the opposite side of the motor 55 from the forced draft fan, and the fan is arranged to draw air through an air inlet opening 71 in the front of the heater and through an air space beneath the fire box and discharge the air into the air space 16 of the heater, whereby the air is heated by passing over the heated walls of the fire box. The pressure of the heated air in the air space 16 forces the air through the tubes of the heat exchanger 20 and through suitable outlet openings 73, which may be arranged in the upper side portions of the heater casing to deliver the heated air into the room. The arrangement of the motor and air circulating fan is such that the cool air drawn in from the adjacent floor of the room is passed over the motor, thus serving to keep the motor cool. Preferably, the motor and fans are enclosed within a chamber or housing 74 which may be separated by an air space from the fire box and provided with walls of heat and sound insulating construction adapted to deaden the noise of operation of the motor and fans.

In the heater as illustrated in Fig. 1, a false mantel or covering shell is provided comprising upper and lower sections 75, 76, which may be shaped and ornamented to simulate a built-in fireplace and chimney, thus giving the heater the appearance of an ordinary fireplace and chimney. The upper section 76 of the shell is preferably arranged so that it can be adjusted upwardly or downwardly over the casing 10 of the heater through an opening in the top or mantel shelf of the lower section 75 of the shell so as to thus adapt the shell to different ceiling heights.

By reason of the hereinbefore described construction and operation of the heater, it will be understood that the device can be operated with safety as an open fireplace and afford the pleasures of an open fire without the accompanying fire hazards so often involved, and without the necessity for the heavy installation expense for the ordinary open fireplace. Because of the provisions for a forced draft and the heat exchanger 75 which acts to cool or condense the smoke, the

smoke pipes can be of small diameter, pipes of not over approximately four inches in diameter being sufficient to maintain a fire for ample heating. These factors adapt the heater for use in locations distant from the house chimney or without the necessity for the usual masonry chimney. If the operating motor for the forced draft fan should fail for any reason, such as the failure of the electric current, to produce the draft necessary to properly maintain the fire, the safety front gate will be automatically closed and the safety smoke flue opened so as to provide for the discharge of smoke out of doors by natural draft, and prevent its escape into the house. On the other hand, danger from overheating is prevented by the closing of the front gate and, thereby, the checking of the fire under the control of the thermostatic switch. The heater can be made of a size and form adapting it to be used in an ordinary fireplace and ensure proper operation of the fire without smoking in a fireplace which may not function properly because of faulty design of the same or its chimney. Furthermore, the front gate can be more or less closed and the heater used as a stove and the fire regulated by appropriate adjustments of the front gate.

I claim as my invention:

1. A movable closure gate for an open-front heater and control mechanism for said gate comprising stationary upright toothed racks at opposite edges of said gate, a shaft rotatably mounted on said gate and having pinions fixed thereto and meshing with said racks, an upright toothed rack which is shiftable for engaging one or another of its teeth with a part on and movable with said gate for holding said gate in different more or less open positions, and actuating means for moving said shiftable rack into and out of engagement with said part on the gate for holding and releasing the gate.

2. A movable closure gate for an open-front heater and control mechanism for said gate comprising, stationary upright toothed racks at opposite edges of said gate, a shaft rotatably mounted on said gate having pinions fixed thereto and meshing with said racks, a spring arranged to rotate said shaft and pinions in a direction for moving said gate toward a closed position, a holding device engageable with a part attached to and movable with said gate in different positions of the gate to hold the gate in said different positions against the closing action of said spring, and means for actuating said holding device to release said gate and allow it to close.

3. A movable closure gate for an open-front heater and control mechanism for said gate comprising, stationary upright toothed racks at op-

posite edges of said gate, a shaft rotatably mounted on said gate having pinions fixed thereto and meshing with said racks, a spring arranged to rotate said shaft and pinions in a direction for moving said gate from an open to a closed position, an upright shiftable toothed rack, and means for shifting said rack to engage and disengage different teeth thereof with a part on and movable with said gate for holding the gate in different more or less open positions and for releasing said gate to allow the gate to close.

4. A movable closure gate for an open-front heater and control mechanism for said gate comprising, guides at opposite edges of said gate in which said gate is movable for closing said front, stationary toothed racks extending lengthwise in said guides, a shaft rotatably mounted on said gate and having pinions fixed thereto and meshing with said racks, a spring arranged to rotate said shaft and pinions in a direction to close said gate, a shiftable toothed rack extending lengthwise adjacent one of said guides, means for shifting said rack to engage said shaft in different more or less open positions of said gate for holding the gate from closing, and means for shifting said rack to disengage said shaft for releasing said gate for closing.

5. A movable closure gate for an open-front heater and control mechanism for said gate comprising, a toothed rack which is arranged lengthwise in the direction of movement of said gate and is shiftable for engaging different teeth thereof with a part connected to and movable with said gate for holding the gate in different more or less open positions, actuating means for shifting said rack into and out of holding engagement with said part for holding and releasing the gate, and means for closing said gate when released.

6. A portable fire place comprising a fire box having an open front, and a smoke flue leading from the fire box, a movable gate for closing said open front, a device which normally releasably holds said gate open in opposition to force tending to close the gate, a motor and a fan driven thereby for creating a forced draft through said smoke flue, a safety smoke flue communicating with said fire box, a damper normally closing said safety flue, and means controlled by the speed of said motor which retain said holding device in gate-holding position during normal speed of the motor and which operate in response to a predetermined reduction in the speed of said motor to actuate said holding device to release said gate and allow it to close, and also to actuate said damper to open said safety smoke flue.

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