April 15, 1930. H. R. HUMPHREY ET AL 1,754,952

HEATING APPARATUS

Filed Nov 3, 1928 3 Sheets-Sheet 1

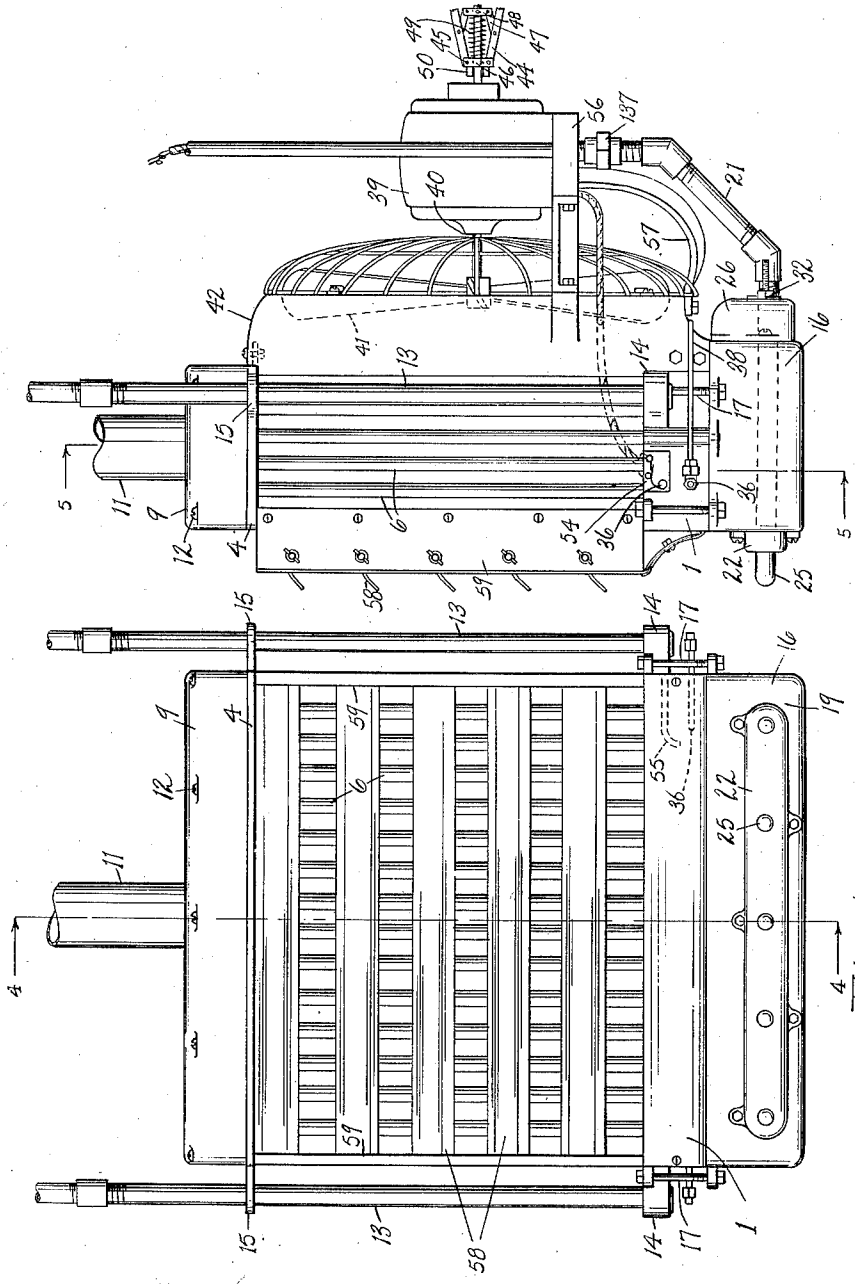

Fig. 2.

Fig. 1.

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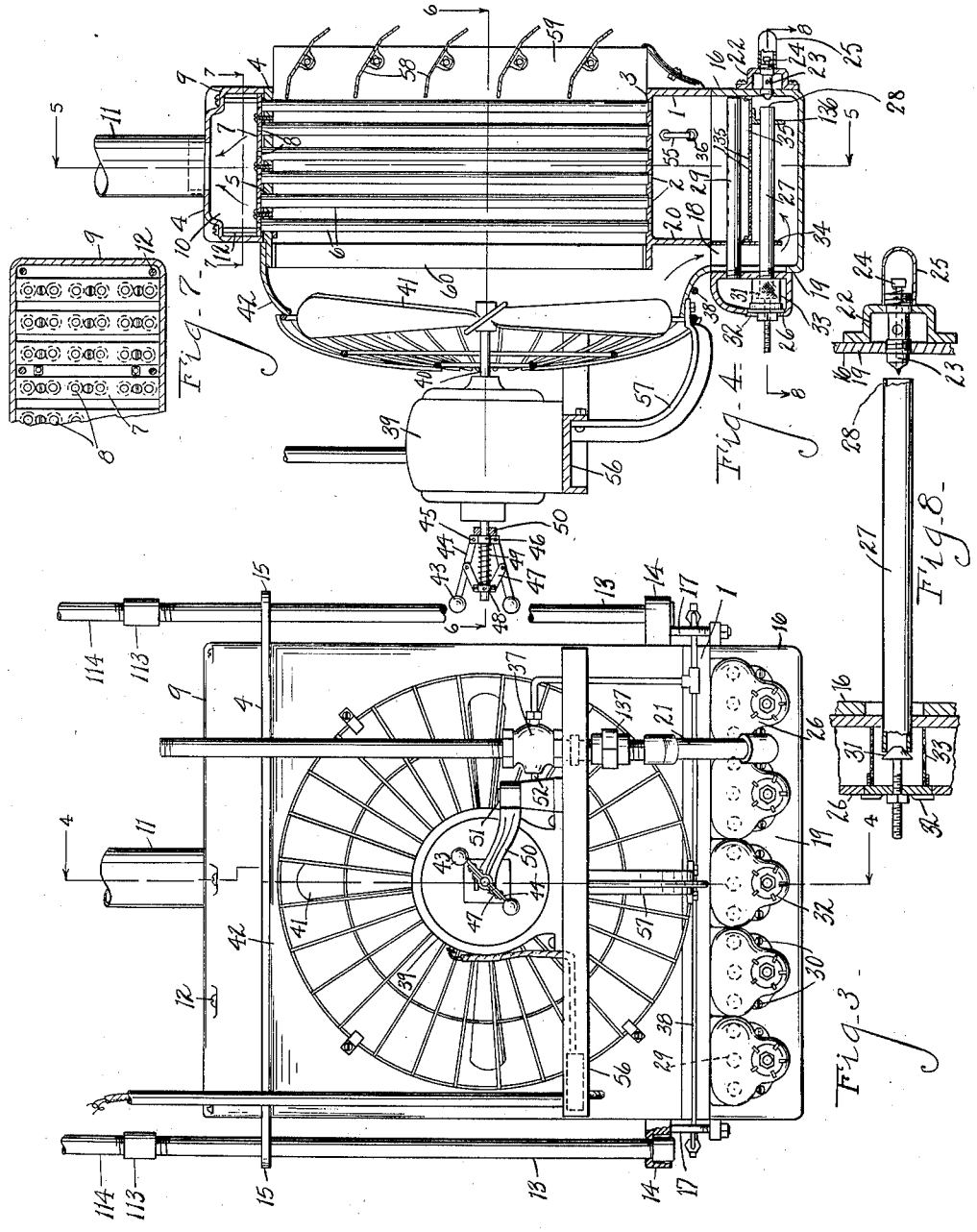

Fig. 7.

Fig. 4.

Fig. 8.

Fig. 3.

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Filed Nov. 3, 1928 3 Sheets-Sheet 3

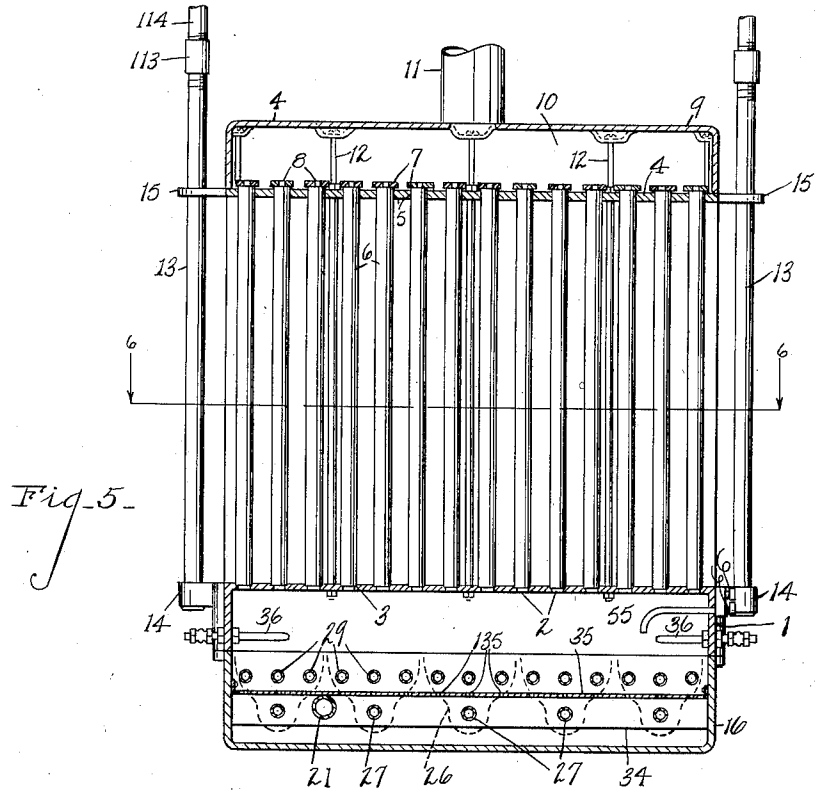

Fig. 5.

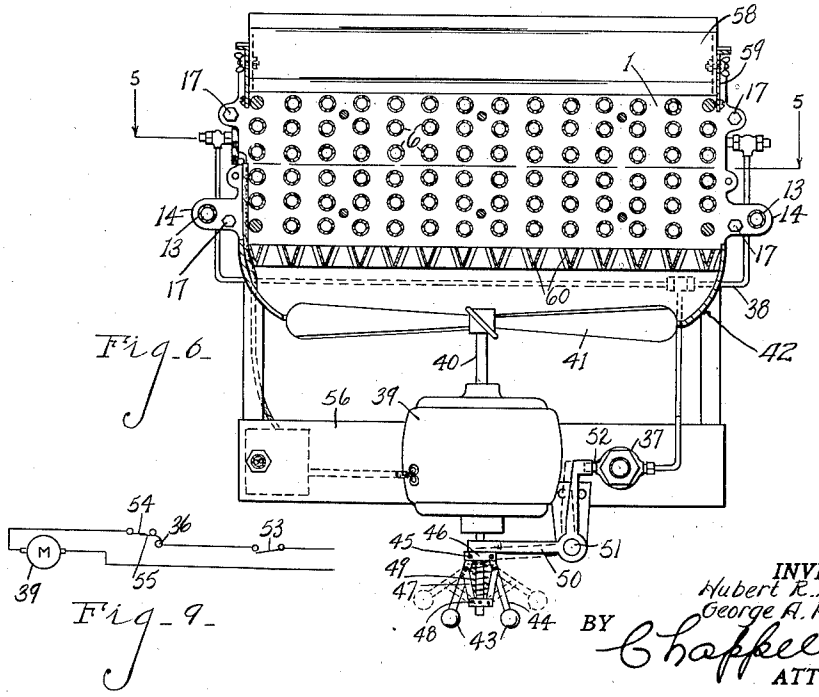

Fig. 6.

Fig. 9.

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HEATING APPARATUS

Application filed November 3, 1928. Serial No. 314,017.

The main objects of this invention are:

First, to provide a heating apparatus which is highly efficient, of large capacity and at the same time compact in structure.

Second, to provide a heating apparatus which is well adapted for heating garages, factories and the like and may be suspended in the upper part of a room, and at the same time effectively distributes the heat and circulates the air within the room.

Third, to provide in a heating apparatus an automatic control for the main or heating burner which provides a maximum of safety, the main burner being automatically lighted from a pilot and the main burner valve control mechanism being rendered inoperative on extinguishing the pilot.

Fourth, to provide a heating apparatus in which the heated gases and products of combustion are circulated through the radiating unit under pressure.

Fifth, to provide in a heating apparatus an improved burner structure.

Objects pertaining to details and economies of construction and operation of our invention will definitely appear from the description to follow. The invention is defined in the claims.

A structure which embodies the features of our invention is illustrated in the accompanying drawings in which:

Fig. 1 is a front elevation of our improved heating apparatus, the discharge flue and hangers being partially broken away.

Fig. 2 is a side elevation.

Fig. 3 is a fragmentary rear elevation.

Fig. 4 is a detail view partially in vertical section on line 4—4 of Figs. 1 and 3.

Fig. 5 is a detail view partially in vertical section on line 5—5 of Figs. 2, 4 and 6.

Fig. 6 is a detail view mainly in horizontal section on line 6—6 of Figs. 4 and 5.

Fig. 7 is a detail section on line 7—7 of Fig. 4.

Fig. 8 is a detail view partially in horizontal section on line 8—8 of Fig. 4 showing details of the burner.

Fig. 9 is a diagrammatic view showing the relation of the pilot burner and cut-out switch to the motor.

In the embodiment of our invention illustrated we provide a base member 1 provided with a plurality of discharge openings 2 surrounded by flue seats 3. The top member 4 is provided with openings 5 through which the upper ends of the flues 6 project, these flues being arranged with their lower ends in the seats 3. The flues are preferably arranged in aligned rows as illustrated and we have found that highly satisfactory results are secured when they are formed of copper tubing of relatively small dimensions, the flues constituting a radiator unit.

The flues are held against their seats and their discharge ends are restricted by means of flue clamping strips 7 which are secured to the top member to engage the upper ends of the flues and provided with openings 8 which substantially restrict the discharge of the tubes.

The header member 9 is arranged on the top member to provide a discharge header 10 for the flues, the discharge flue 11 being connected centrally to this header. In practice this flue 11 is also of relatively small diameter and constitutes a restricted discharge for the radiator unit. The tie bolts 12 connect the header member 9 to the base member, thereby clamping these elements or parts in assembled relation.

The hanger rods 13 are inserted through lugs 14 on the base member and are arranged through arms 15 projecting at the ends of the top member. These hanger rods are swiveled in the lugs 14, rotatable in the arms 15 and threaded at their upper ends so that they may be engaged with couplings 113 on the lower ends of the supports 114, thus providing a very simple and convenient means for mounting the apparatus in a suspended position.

The burner housing 16 is clamped on the under side of the base member by means of the bolts 17 and coacts with the base member in providing a combustion chamber. The combustion chamber is substantially closed with the exception of the air inlet 18, the rear wall 19 of the burner housing being disposed in spaced relation to the rear wall 20 of the base member to provide this air inlet

which extends across the combustion chamber.

The gas supply pipe 21 is connected to a header 22 mounted on the front side of the burner housing and provided with a plurality of nozzles 23 delivering through the front wall of the housing. The regulating valves 24 of the nozzles are adjustable from the front of the housing and are provided with removable caps 25. The nozzles 23 are removable so that the apparatus may be supplied with nozzles having orifices of suitable size so that the apparatus can be readily adapted for natural gas or for artificial gas.

We provide a plurality of burner units each consisting of a chambered head member 26 carrying a mixing tube 27 which extends across the combustion chamber into operative relation to the nozzle 23. The primary air inlet 28 of the mixing tube is within the combustion chamber and adjacent the nozzle.

Each header is provided with a plurality of tubular burners 29 which are disposed in a plane above the mixing tubes.

The burner units are secured to the rear wall of the burner housing member by means of the screws 30, the rear wall having openings therein to receive the burners and the mixing tubes so that these units may be independently removed.

The conical valves 31 coact with the ends of the mixing tube and are adjustable from the outside of the head members. These valves are carried by blocks 32 which also carry tubular screens 33 surrounding the ends of the mixing tubes as shown in Fig. 8. The screens may be thus readily removed for cleaning.

The baffle plate 34 depends from the rear wall 20 of the base member in spaced relation to the rear wall of the burner housing to provide a down-passage delivering to the bottom of the combustion chamber—see Fig. 4.

We preferably provide an air directing plate 35 which is arranged horizontally between the burners and mixing tubes, as shown in Figs. 4 and 5, this plate being provided with rows of secondary air inlet openings 135 arranged below the burners 29 so that the secondary air is effectively directed to the burners. Further, the secondary air serves as a cooling means for the burners. The air passing through the opening 18 flows across the burners and also serves as a cooling means. These burners in practice are preferably formed of an alloy containing chromium such as stainless steel or michrome, which material is capable of withstanding the heat without material change. An air directing baffle 136 for the primary air depends from the air directing plate 35 to receive the inner ends of the mixing tubes, the secondary air for the mixing tubes passing beneath this directing baffle. This prevents the forming of disturbing air currents around the primary air inlets as the air under pressure or blast of air is delivered to the combustion chamber.

A pilot 36 preferably a gas pilot is provided at each end of the combustion chamber. These pilot burners are shown conventionally. The pilots are connected to the gas supply pipe 21 in advance of the main burner control valve 37 by means of the conduits 38.

At the rear of the radiating unit we mount a blower consisting, in the embodiment illustrated, of the electric motor 39 having a shaft 40 projecting at each end thereof on the forward ends of which the fan blades 41 are mounted. An air directing hood 42 is provided to direct the air to the radiating tubes and also to the air inlet 18—see Fig. 4—so that air is delivered by the blower across the radiating flues and to the combustion chamber.

On the rear end of the motor shaft we mount a governor device consisting of the governor balls 43 carried by the arms 44 pivoted at 45 on the sliding collar 46. These arms are connected by the links 47 to a fixed collar 48 on the motor shaft. A spring 49 disposed between these collars acts to hold the governor balls inwardly in the position shown in Fig. 4. When the motor is running, however, the governor seats are thrown out by centrifugal action, acting upon the valve lever 50 pivoted at 51 to coact with the stem 52 of the valve designated generally by the numeral 37, thereby opening the valve and supplying gas to the main burner when the motor is in operation. The gas supply pipe is cut off when the motor stops so that the apparatus may be controlled from a control switch 53—see Fig. 9.

To prevent the opening of the gas valve in the event the pilot becomes extinguished, we provide a cut-out switch designated generally by the numeral 54 (Fig. 9) which is associated with a thermal element 55 disposed in such relation to one of the pilots, as shown in Fig. 5, that the thermal element is heated thereby and maintains the switch in closed position. Should the pilot become extinguished, however, the thermal element cools, opening the cut-out switch so that the motor cannot be started until the pilot is relighted and the switch again closed through the thermal element. Should the pilot become clogged or extinguished while the main burner is in operation, the heat of the main burner will maintain the cut-out switch closed so that the cut-out switch opens only when the current is off. However, once having opened, it is not possible to start the apparatus until the pilot has been relighted.

The motor is carried by a bracket 56 extending rearwardly from the hood 42, a sup-

porting arm 57 being also provided for supporting the bracket.

At the front of the radiating tubes we mount a series of adjustable louvers 58 carried by the side plates 59 and being capable of adjustment so that the heated air may be directed downwardly to the degree desired. At the rear of the radiating tubes we provide a series of deflectors 60 of rearwardly tapered cross section, these being aligned with the rows of tubes and serving to distribute the current of air delivered from the blower quite uniformly throughout the radiator units. These units being tapered substantially reduces the resistance or baffling effect which results from delivering the air directly against the tubes.

By delivering the air from the blower to the combustion chamber highly efficient combustion of the gas is maintained. This enables the making of a very compact unit of large capacity; a large amount of gas may be efficiently burned in a relatively small combustion chamber and the radiating capacity of the radiator unit is much more efficient than would otherwise be possible. The heated gases and products of combustion are forced through the flues which renders it practical to employ flues of relatively small dimensions or to restrict the discharge therefrom. The restricted outlets of the flues result in maintaining the heated gases therein until a very large percentage of the heat is transferred, and also renders it possible to use a relatively small discharge flue 11 without impeding the proper circulation. A low stack or discharge flue temperature may be had without danger from condensation.

The burners being mounted in the burner housing as described, this housing and the burners constitute an assembled unit which may be removed by releasing the bolts 17 and loosening the coupling 137 for the gas pipe 121 when the burner unit or the housing 16 mounted therein may be swung to one side thereby exposing all of the burners for inspection and also exposing the radiating flues so that they may be cleaned from below as by means of a brush or other suitable flue cleaner. The flues being arranged in rows allows for the free delivery of air through the radiator unit as by means of a fan.

Our improved heating apparatus is very efficient both in the matter of heating capacity and in the utilization of a large percentage of heat units. The apparatus has the advantages of safety and is very compact in proportion to capacity.

We have illustrated and described our improvements in an embodiment which we have found very satisfactory. We have not attempted to illustrate and describe other embodiments and adaptations as we believe this disclosure will enable those skilled in the art to embody or adapt our improvements as may be desired.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent, is:

1. In a heating apparatus, the combination of a chambered base member having a plurality of combustion chamber discharge openings surrounded by upwardly facing flue seats, a top member having a plurality of flue openings therein, radiating flues of relatively small diameter arranged with their upper ends through said openings in said top member and their lower ends in said seats in said base member, flue clamping strips mounted on said top member to engage the upper ends of said flues and having restricted flue discharge openings therein, a flue header member mounted on said top member to coact therewith to provide a flue header, said header being provided with a discharge flue, a burner housing member mounted on said base member to coact therewith to provide a combustion chamber, and gas burners mounted on said burner housing member and having primary air inlets opening therein.

2. In a heating apparatus, the combination of a base member having upwardly facing flue seats, a top member having a plurality of flue openings therein, radiating flues arranged with their upper ends through said openings in said top member and their lower ends in said seats in said base member, flue clamping strips mounted on said top member to engage the upper ends of said flues, and a flue header member mounted on said top member to coact therewith to provide a flue header.

3. In a heating apparatus, the combination of a combustion chamber, radiating flues opening thereto and arranged in aligned rows, a burner, a blower mounted to deliver air across said flues, and deflectors of tapered cross section arranged between said blower and the rows of flues with their apexes toward the blower.

4. In a heating apparatus, the combination of a radiating unit comprising a plurality of flues arranged in rows from front to rear, means for delivering air across said flues in the direction of the aligned rows, and deflectors of tapered section arranged in alignment with the rows of flues with their apexes towards the air delivery means.

5. In a heating apparatus, the combination of a radiating unit comprising a plurality of flues arranged in rows from front to rear, means for delivering air across said flues in the direction of the aligned rows, and deflectors arranged in alignment with the rows of flues.

6. In a heating apparatus, the combination of a combustion chamber, radiating flues opening thereto and arranged in rows, a burner arranged in said combustion chamber, a

header to which said flues deliver, a blower mounted to deliver air across said flues, and deflectors of tapered section arranged between said blower and the rows of flues with their narrow edges toward the blower.

7. In a heating apparatus, the combination of a combustion chamber, radiating flues opening thereto and arranged in rows from front to rear, a header to which said flues deliver, said radiating flues having restricted discharge openings to said header, a relatively small discharge flue for said header, a burner, and means for supplying primary and secondary air to said burner under pressure and discharging air across said radiator flues in the direction of their aligned rows.

8. In a heating apparatus, the combination of a combustion chamber, a flue header, a plurality of flues of relatively small diameter extending between said combustion chamber and header and having restricted discharge openings to said header, a burner arranged within said combustion chamber, and means for delivering a blast of air across said radiating flues and to the primary air inlets of said burner and to said combustion chamber.

9. In a heating apparatus, the combination with a combustion chamber, of radiating flues opening thereto, a header to which said flues deliver, said header being provided with a discharge flue of substantially less capacity than that of the radiating flues, a burner arranged in said combustion chamber, and means for discharging air across said radiating flues and delivering air under pressure to said combustion chamber.

10. In a heating apparatus, the combination of a closed combustion chamber, a flue header, radiating flues connected to said combustion chamber and having restricted discharge openings to said header, burners arranged within said combustion chamber and having primary air inlets opening therein, a blower, and an air directing hood for said blower arranged to direct air across said flues and to said combustion chamber.

11. In a heating apparatus, the combination of a closed combustion chamber provided with an air inlet, a burner arranged within said combustion chamber and having a primary air inlet opening therein, a plurality of radiating flues connected to said combustion chamber and having restricted discharge openings, and means for delivering air across said flues and to said combustion chamber.

12. In a heating apparatus, the combination of a combustion chamber, a flue header, radiating flues opening to said combustion chamber and flue header, a plurality of burners arranged horizontally within said combustion chamber, mixing tubes operatively associated with said burners and having primary air inlets within said combustion chamber, and means for discharging air across said radiating flues and delivering air to said combustion chamber.

13. The combination with a closed burner chamber, of a plurality of radiating flues opening to said burner chamber and provided with a restricted discharge, a burner arranged with its primary air inlet opening to said chamber, and means for delivering air under pressure to said burner chamber.

14. In a heating apparatus, the combination of a combustion chamber, a flue header, radiating flues opening to said combustion chamber and flue header, a burner within said combustion chamber, and means for discharging a blast of air across said radiating flues and delivering air to said combustion chamber.

15. In a heating apparatus, the combination of a combustion chamber, radiating flues connected to said combustion chamber, a burner within said combustion chamber having a primary air inlet opening therein, and means for discharging air across said radiating flues and delivering air to said combustion chamber.

16. The combination with a combustion chamber, of a plurality of radiating flues connected to said combustion chamber, a burner, and means for supplying primary and secondary air to said burner and inducing a forced circulation of the products of combustion and heated gases through said flues and adapted also for discharging air across said flues.

17. The combination with a combustion chamber, of a radiator unit operatively associated with said combustion chamber, said radiator being provided with a restricted discharge passage, a burner disposed with its primary and secondary air inlets within said combustion chamber, and means for delivering air to said combustion chamber for supplying air to said burner and maintaining a forced circulation of the heated gases and products of combustion through said radiator unit, and for delivering air across said radiator unit.

18. The combination with a burner, of a radiator unit operatively associated with said burner so that the products of combustion and heated gases from the burner are delivered through said radiator unit, said radiator unit having a restricted discharge, and means for delivering primary and secondary air under pressure to said burner and for inducing a forced circulation of the products of combustion and heated gases through said radiator unit.

19. The combination with a combustion chamber, of a burner disposed with its primary and secondary air inlets within said combustion chamber, a radiator unit connected to said combustion chamber so that the products of combustion and heated gases circulate through said radiator, and means for

delivering air under pressure to said burner combustion chamber and across said radiator unit.

20. In a heating apparatus, the combination of a combustion chamber, a radiator unit operatively associated with said combustion chamber to receive the products of combustion therefrom, a burner arranged in said combustion chamber and having its primary air inlet opening thereto, and means for supplying air under pressure to said combustion chamber.

21. The combination with a burner, of a radiator unit operatively associated with said burner, and means for delivering primary and secondary air under pressure to said burner and discharging air across said radiator unit.

22. The combination with a burner, of a radiator unit operatively associated with said burner, and means for supplying primary and secondary air under pressure to said burner for creating a forced draft through said radiator unit and for discharging a blast of air across said radiator unit.

23. The combination with an inclosed burner and a radiator unit operatively associated with said burner, of means for delivering a blast of air to said burner and across said radiator unit.

24. In a heating apparatus, the combination of a closed combustion chamber provided with an air inlet, a radiator element operatively associated with said combustion chamber, a main burner arranged within said combustion chamber and having a primary air inlet opening therein, a pilot arranged within said combustion chamber, a control valve for said main burner, a motor mounted at one side of said radiator element and provided with a driving shaft projecting at both ends, fan blades on the forward end of said shaft, a valve controlling mechanism including a governor device mounted on the rear end of said motor shaft and acting to open the valve while the motor is running, a cut-out switch for said motor including a thermal element operatively associated with said pilot whereby the pilot acts to maintain the switch in closed position while the pilot is operative, and an air directing hood operatively associated with said fan blades to direct the air across said radiator element and to said air inlet of said combustion chamber.

25. In a heating apparatus, the combination of a closed combustion chamber provided with an air inlet, a radiator element operatively associated with said combustion chamber, a main burner arranged within said combustion chamber and having a primary air inlet opening therein, a pilot arranged within said combustion chamber, a control valve for said main burner, a motor mounted at one side of said radiator element and provided with a driving shaft projecting at both ends, fan blades on the forward end of said shaft, a valve controlling mechanism including a governor device mounted on the rear end of said motor shaft and acting to open the valve while the motor is running, and an air directing hood operatively associated with said fan blades to direct the air across said radiator element and to said air inlet of said combustion chamber.

26. In a heating apparatus, the combination of a closed combustion chamber, a radiator unit operatively connected with said combustion chamber to constitute outlets therefor, a main burner arranged within said combustion chamber and having a primary air inlet opening therein, a pilot arragned within said combustion chamber, a control valve for said main burner, a blower including a motor for delivering air to said radiator element and to said combustion chamber, a valve control mechanism operatively associated with said motor and acting to open the valve when the motor is running, and a cut-out switch for said motor including a thermal element operatively associated with said pilot whereby the pilot acts to maintain the switch in closed position.

27. In a heating apparatus, the combination of a closed combustion chamber, a heat radiating unit connected to said combustion chamber to constitute an outlet therefor, a main burner arranged within said combustion chamber and having a primary air inlet opening therein, a pilot arranged within said combustion chamber, a control valve for said main burner, a blower including a motor for delivering air across said radiating unit and to said combustion chamber, and a valve control mechanism operatively associated with said motor and acting to open the valve when the motor is running.

28. In a heating apparatus, the combination of a radiating unit, a main burner operatively associated with said radiating unit, a pilot operatively associated with said main burner, a control valve for said main burner, means for delivering a blast of air to said radiating unit including a motor, a valve control mechanism including a governor device operatively connected to said motor and acting to open the valve while the motor is running, and a cut-out switch for said motor including a thermal element operatively associated with said pilot whereby the pilot acts to maintain the switch in closed position.

29. In a heating apparatus, the combination of a radiating unit, a main burner operatively associated with said radiating unit, a pilot operatively associated with said main burner, a control valve for said main burner, means for delivering a blast of air to said radiating unit including a motor, and a valve control mechanism including a governor device operatively connected to said motor and acting to open the valve while the motor is running.

30. In a heating apparatus, the combination of a main burner, a pilot operatively associated with said main burner, a control valve for said main burner, a valve mechanism including a motor and acting to open the valve while the motor is running, and a cut-out switch for said motor including a thermal element operatively associated with said pilot whereby the pilot acts to maintain the switch in closed position.

In witness whereof we have hereunto set our hands.

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