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HEATING SYSTEM

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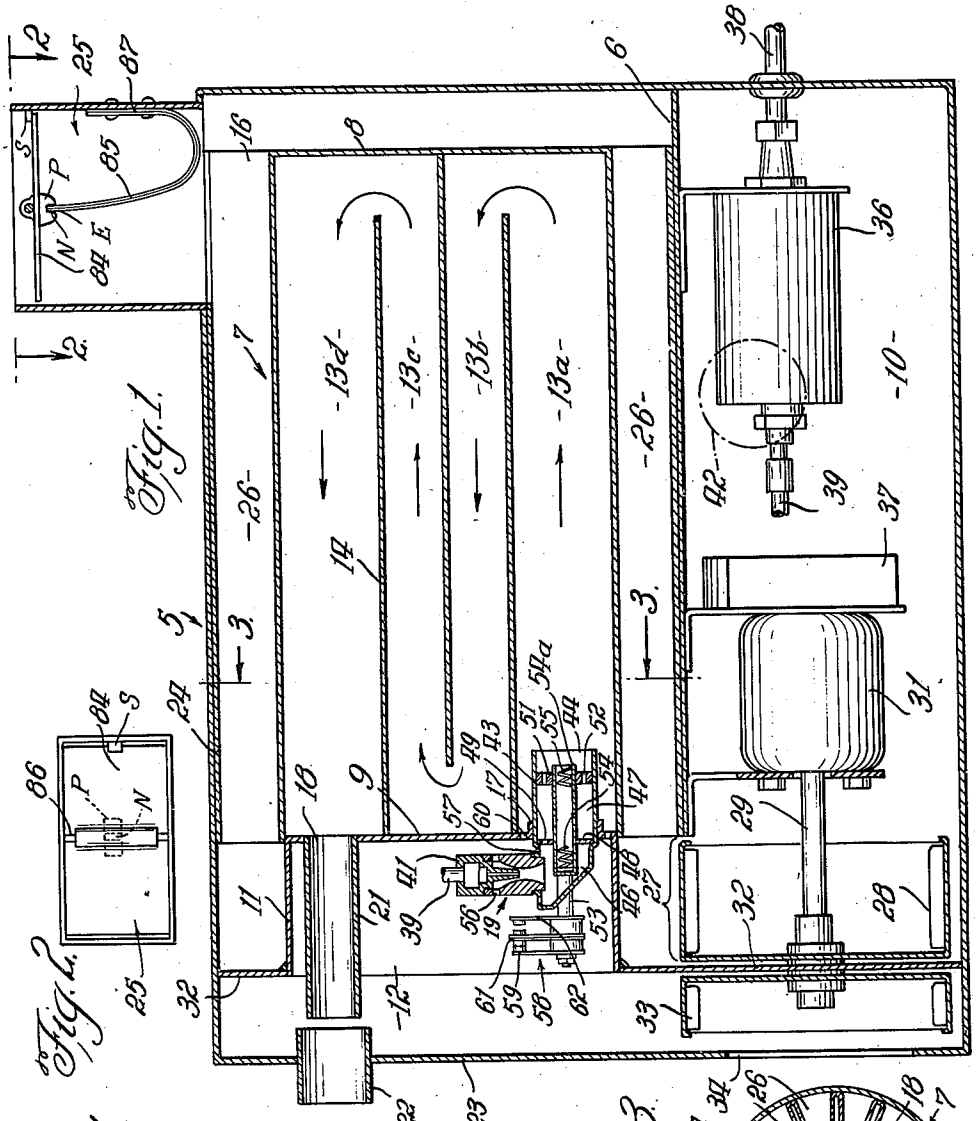


Fig. 1.

Fig. 2.

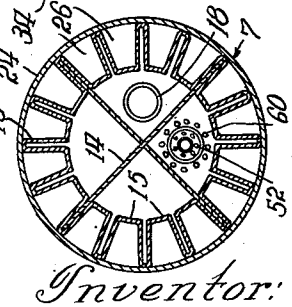


Fig. 3.

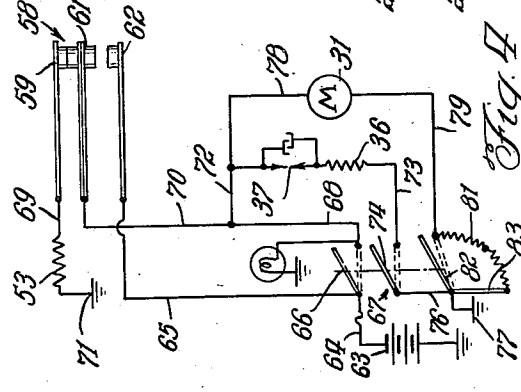


Fig. 4.

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HEATING SYSTEM

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11 Claims. (Cl. 126—110)

This invention relates generally to heating systems and in particular to a heating system of internal combustion type.

Heating systems of internal combustion type may be classified generally into two types, one type having continuously operated igniting means, and the other type having intermittently operated igniting means. In both these types of heating systems there is always the danger of an explosion taking place when burning is first initiated due to possible fuel accumulations within the combustion chamber of the heating system. This danger is usually greatest when the system is started after a stop period because of the time factor involved permitting fuel to accumulate within the combustion chamber. In the type of heating system utilizing intermittently operated igniting means, however, this danger may arise further each time the ignition means is operated. These explosions of course are very objectionable from a safety standpoint and are further objectionable from a noise standpoint particularly where the heating system is utilized in close proximity to people such as in the heating of the passenger compartment of a mobile craft.

It is an object of this invention, therefore, to provide a heating system of internal combustion type which is capable of being started and operated at all times without danger of explosive charges being ignited therein.

Another object of this invention is to provide an improved heating system of internal combustion type.

A further object of this invention is to provide a heating system of internal combustion type which is simple in design, rugged in construction and adapted to be efficiently and safely operated over prolonged operating periods with a minimum of servicing attention and adjustments.

A feature of this invention is found in the provision of an air heating unit having intermittently operated ignition means, in which a maximum scavenging action is produced in the combustion chamber when the ignition means is energized. As a result the combustible mixture is flowing through the combustion chamber at a higher rate when ignition takes place and burning thereof is initiated smoothly and without violence.

Further objects, features, and advantages of this invention will become apparent from the following description when taken in connection with the accompanying drawing in which:

Fig. 1 is a longitudinal sectional view of the complete heating unit of this invention, with the combustion chamber thereof being shown in development;

Fig. 2 is a view taken along the line 2—2 of Fig. 1 showing a valve structure for controlling the passage of heated air from the heating unit;

Fig. 3 is a transverse sectional view of the combustion chamber as seen along line 3—3 in Fig. 1; and

Fig. 4 is a diagrammatic electrical circuit for the heating unit.

In practicing this invention there is provided an air heating system of internal combustion type including a combustion chamber having a passage for air to be heated in thermal relation therewith. Also in thermal relation with the combustion chamber and operatively associated therewith is an air and fuel mixing device which is heated by a combination electrical unit to at least a fuel vaporizing temperature to mix together the air and fuel therein. The heating unit includes an igniter portion located in the combustion chamber. During the operation of the heater the combination unit is operated intermittently by first thermostatic means connected in the circuit for the combination unit and responsive to the temperature of the air and fuel mixing device to operate such unit. Other thermostatic means is located in the heated air passage and is responsive to the temperature of the heated air to actuate valve means for closing such passage. A fan for supplying air to the mixing device and a fan for circulating air through the air passage are driven by a common series wound motor. The air delivered by the supply fan moves the gas mixture through the combustion chamber. In other words this air acts to scavenge the combustion chamber. When the air passage is closed by the above-noted valve means the load on the air circulating fan is reduced. This reduction in the fan load results in an increase in the speed of the motor and in a corresponding increase in the speed of the air supply fan and in the quantity of air delivered thereby. This increase in the supply air increases the air flow and hence the scavenging action in the combustion chamber. The first and other thermostatic means are set relative to each other to operate at temperature such that the air passage is closed prior to and at least when the combination unit is energized. As a result a maximum scavenging action is produced in the combustion chamber when the combination unit is energized so that burning of the combustible mixture within the combustion

chamber is initiated smoothly and without explosive violence.

Referring to Fig. 1 the heating system of this invention is seen to include a housing 5 which is divided longitudinally thereof over substantially its entire length by a vertically extending partition member 6 to provide a mechanical compartment 10 and a heating compartment. Within the heating compartment is a substantially cylindrically shaped combustion chamber 7, shown in development in Fig. 1 for the purpose of clarity, which is closed at one end by a cover plate 8 and at its opposite end by the bottom 9 of a substantially dish-shaped member 11. The member 11 defines in part an air supply chamber 12 which is in axial alignment with the combustion chamber 7.

The combustion chamber 7 is divided longitudinally thereof into four axially extending but connected passages 13*a*–13*d* by a partition member 14 of substantially X-shape (Fig. 3). The combustion chamber inlet 17 and outlet 18 are formed in the bottom portion 9 of the member 11 in communication with the passages 13*a* and 13*d*, respectively. Located within the inlet 17 is an air and fuel mixing means, indicated generally as 19, which is extended within the air supply chamber 12. The outlet 18 is provided with a tail pipe 21 projected within the air supply chamber 12. Also projected within the air supply chamber 12 and in co-axial alignment with the tail pipe 21 but axially spaced therefrom is a second pipe 22 carried in the end 23 of the housing member 5.

The outer wall or body portion of the combustion chamber 7 is integrally formed with alternately arranged peripheral portions 15 and doubled fin portions 16, which are angularly spaced about the combustion chamber and extended axially thereof. The side portions of the partition member 14 are located within certain ones of the fins 16 and retained therein in a fixed position relative to the combustion chamber body portion by welding or like means. The fins 16 have a sleeve 24 positioned about the outer end thereof so as to form an annular passage 26 about the combustion chamber 7 for air to be heated.

The air to be heated is admitted into the passage 26 through an inlet 27 connecting the passage with the mechanical compartment 10 and is circulated through the passage 26 by a fan 28 located within the compartment 10 and mounted on a shaft 29 of a series wound electric motor 31. The compartment 10, and air passage 26 are separated from the air supply chamber 12 by a sealing or partition member 32 extended transversely of the housing 5. From Fig. 1 it is seen that the air supply chamber 12 is defined by the dish-shaped member 11, the partition member 32, and the end 23 of the housing 5. Air circulated by the fan 28 is thus confined to travel within the compartment 10 and passage 26 and is discharged from the passage through an outlet 25 which is connected to a space to be heated.

The supply chamber 12 receives air from a fan 33 located therein and mounted on the motor shaft 29 which is journalled in the partition plate 32. An inlet 34 for the fan 33 is provided in the housing end 23. It is seen, therefore, that the fans 28 and 33 are operated by a common electric motor 31 and are mounted directly on the shaft 29 thereof.

The motor 31 is also utilized in the operation of a fuel pump 36 which is illustrated in Fig. 1 as being of solenoid type. It is to be understood, of course, that any electrically or cam-operated pump may be used. The breaker assembly 37 for controlling the energization of the pump 36 is operatively associated with the motor shaft 29. Fuel for the pump 36 is supplied thereto from a suitable source (not shown) through pipe 38, and is delivered through a pipe 39 to a fuel injection nozzle 41 formed as a part of the air and fuel mixing means 19. The pump 36, breaker assembly 37, motor 31 and fan 28 are thus all located within the mechanical compartment 10, which is provided with an inlet 42 for supplying either fresh or recirculated air to the fan 28 for delivery to the air passage 26.

The air and fuel mixing means 19, previously mentioned, includes a substantially tubular shaped housing member 43 which is closed at one end and open at the end 44 thereof with the passage 13*a*. A mixing chamber 46 is located at the closed end of the casing 43, and is separated from an equalizing chamber 47 by a plate member 48 have perforations 49 therein. The equalizing chamber 47 in turn is both defined and separated from the combustion chamber passage 13*a* by a heat insulating plate 51 having perforations 52 therein. Extended substantially axially through the casing 43 and projecting outwardly from the closed end thereof is a combination heating and igniting unit 53 including a resistance coil 54 supported in a spaced relation within a heat conducting tube 54*a* composed of copper or like material. The casing 43 and partition plate 48 are provided in a heat conducting material and are in thermal connection with the combination unit 53 so as to readily receive heat therefrom. The combination unit 53 is adapted to heat the air and fuel mixing means 19 to at least a fuel vaporizing temperature to facilitate the mixing together of the air and fuel admitted therein, and to ignite such mixture for burning within the combustion chamber 7.

The fuel delivered to the fuel injection nozzle 41 by the pump 36 is directed into the mixing chamber 46, the fuel nozzle being located within the air supply chamber and mounted directly on the casing 43 at the chamber 46 (Fig. 1). A portion of the air for mixing with the fuel enters the nozzle 41 through ports 56 in the fuel nozzle 41 and travels with this fuel into the mixing chamber 46. Further air is admitted directly into the mixing chamber 46 through apertures 57 in the casing 43 and about the fuel nozzle 41. The fuel thus entering the mixing chamber 46 is heated to at least a fuel vaporizing temperature by the action of the heating unit 53 for intimate mixing with the air in such chamber. This vaporous mixture passes into the equalizing chamber 47 through the apertures 49 in the plate member 48. The equalizing chamber acts to reduce turbulence in the mixture and to disperse the mixture substantially uniformly across the entire cross section of the casing 43 so that a mixture of substantially uniform fuel characteristics passes through the apertures 52 in the heat insulating plate 51 and into the igniting zone at the end 55 of the combination unit 53 which functions as a heat gun. In other words the heat developed by the coil 54 is projected outwardly from the unit end 55, the heat generated being dependent upon the watt input to the resistance coil 54.

The air and fuel mixture prepared in the air and fuel mixing means 19 is initially rich to facilitate its ignition by the combination unit 53. It is well known, of course, that although a

rich mixture is more readily ignited than a lean mixture, such rich mixture can not be efficiently and completely burned. This initially rich mixture, therefore, after being ignited is leaned by the addition thereto of secondary or supplementary air from the air supply chamber 12 through ports 60 arranged about the air and fuel mixing means 19 at the inlet 17. Because the open end 44 of the casing 43 is extended beyond the end 55 of the combination unit 53 this supplementary air does not contact the mixture from the mixing means 19 until after such mixture has passed outwardly from the end 44 thereof. Only the initially rich mixture, therefore, is ignited by the combination unit.

To provide a fuel mixture of substantially uniform quality being supplied to the combustion chamber 7 at all times of heater operation there is provided control means for the combination unit 53 including a thermostatic switch unit 58 mounted on the end of the combination unit 53 which is projected outwardly from the closed end of the casing 43. The switch 58 has normally closed contacts 59 and 61, and a contact 62 which is normally open relative to the contact 61 which is of a bi-metal construction so as to be responsive to the action of heat thereon. The operation of the switch 58 is best understood in connection with the electrical circuit shown in Fig. 4.

Referring to Fig. 4 the source of power for operating the heating system is indicated as being a battery 63. The circuit for the combination heating and igniting unit 53 from the battery 63 includes conductor 64 and a pole 66 of a three pole switch 67, conductors 68 and 70, normally closed contacts 59 and 61, conductor 69, the unit 53 and a ground connection 71. The closed position of the switch 67 is shown in dotted lines in Fig. 4. The circuit for the fuel pump 36 from the battery 63 includes conductor 64, switch pole 66, conductors 68 and 72, breaker assembly 37, the pump 36, conductor 73, switch pole 74, and conductor 76 to the ground 77. The circuit for the motor 31 from the battery 63 is common with that of the pump 36 up through conductor 72, and from conductor 72 includes conductor 78, the motor 31, conductor 79, and switch pole 82 to the ground 77. It is seen, therefore, that on closing of the switch 67 the combination unit 53, pump 36 and motor 31 are turned on simultaneously. The switch 67 is of a type such that the switch pole 82 may be moved across a resistor 81, while the poles 66 and 74 are retained in a closed position, so as to vary the speed of the motor during heater operation.

In the operation of the heating system on closing of the control switch 67 the combination unit 53 is energized until the temperature of the air and fuel mixing means 19 is heated to about a fuel vaporizing temperature which for one type of fuel used in the operation of the system is about 200° F. When this temperature is reached the bi-metal contact 61 moves free of the contact 59 and into engagement with the contact 62. The closing of contacts 61 and 62 does not in any way affect the normal operation of the heater but serves a function which will be later explained. When the temperature of the mixing means 19 falls below a temperature of about 200° F. the bi-metal 61 again closes with the contact 59 to close the circuit for the combination unit 53. This cycling operation of the combination unit 53 continues during the normal operation of the heater. The operation of the unit 53 is thus seen to be intermittent rather than continuous.

To stop the operation of the heating system the control switch 67 is moved to its full line position shown in Fig. 4. This movement of the switch opens the circuits for the combination unit 53 and the fuel pump 36 to immediately stop their operation. However, if the mixing means 19 is at a temperature such that the contacts 61 and 62 are closed, the circuit for the motor 31 remains closed from a battery 63 through conductors 64 and 65, contacts 61 and 62, conductors 70, 72, 78 and 79, resistor 81 and conductor 83 to the ground 77. This operation of the motor 31 continues until the heating means 19 has cooled sufficiently to provide for the bi-metal 61 breaking away from the contact 62. This delayed operation of the motor 31 provides for a scavenging of the combustion chamber after the operation of the heater so as to sweep the same of any possible fuel accumulations.

From the above description it is seen that during the normal operation of the heating system air and fuel continues to be supplied to the mixing means 19 and hence to the combustion chamber 7 at all times regardless of whether or not the combination unit 53 is energized. In order to eliminate any sudden and explosive igniting of the mixture in the combustion chamber during the cycling operations of the combination unit 53, as well as in the initial starting of the heater, there are provided means including a flap valve 84 pivoted on an axis 86 intermediate the ends thereof and pivotally movable into a closing position relative to the outlet 25 (Figs. 1 and 2).

The valve 84 at the pivotal support therefor, carries a projecting or lug portion P having a notch N therein for operatively engaging one end E of a bi-metal element 85. The opposite end 87 of the element 85 is secured to the housing 5. The bi-metal 85 is located within the outlet 25 so as to be responsive to the temperature of the heated air in the passage 26 to operate the valve 84. Thus on movement of the element end E toward the left, as viewed in Fig. 1, the valve 84 is moved away from the stop S to a passage opening position. As illustrated in Fig. 1 the fans 28 and 33 are of centrifugal type. Fans of this type have the characteristic of falling off in load on closing of either the inlet or outlet openings in the passages operatively associated therewith. Some propeller type fans also have this characteristic. When the valve 84, therefore, is closed to stop the circulation of air through the passage 26 the load on the fan 28 is appreciably reduced. As was previously mentioned the motor 31 is of series wound type. Thus when the load on the fan 28 is reduced, the speed of the motor 31 increases to in turn increase the speed of operation of the fan 33. The mixture from the mixing means 19 is moved through the combustion chamber 7 by the pressure produced in the air supply chamber 12 by the fan 33. Any variations in the pressure of the air supply chamber thus directly affects the rate of movement of the mixture through the combustion chamber and hence the scavenging action within the combustion chamber. Since this pressure is directly responsive to the speed of operation of the fan 33 it is apparent that any variation in the fan speed correspondingly varies the scavenging action in the combustion chamber 7. Thus on closing of the valve 84 by the bi-metal element 85 there is automatically produced an

increase in the quantity of supply air delivered by the fan 33 and in turn an increase in the scavenging action in the combustion chamber 7 by such air.

The scavenging action is increased further by the Venturi action at the outlet 18 of the combustion chamber produced by the cooperative assembly of the pipes 21 and 22 in the air supply chamber 12. In other words the air passing through the pipe 22 from the supply chamber 12 creates a suction pressure at the end of the pipe which reduces the back pressures in the combustion passage 13*d* to facilitate the discharge of exhaust gases from the combustion chamber. With an increase in pressure in the air supply chamber 12, resulting from an increased speed of the fan 33, this Venturi action is increased concurrently with the increase in the quantity of supply air admitted into the combustion chamber so that the resultant effect of the air from the supply chamber 12 acting on the inlet 17 and at the outlet 18 to scavenge the combustion chamber is additive. A maximum scavenging action, therefore, is developed when the valve 84 is closed.

In the present invention it is contemplated that this maximum scavenging action in the combustion chamber take place prior to or at least when the heating unit 53 is energized so that the mixture within the combustion chamber 7 is in maximum motion at the time ignition occurs. In the operation of the heater the temperatures of the combustion chamber 7 and the air and fuel mixing unit 19 vary in accordance with the rate of combustion within the chamber 7. Thus as burning tends to become slower less heat is generated whereby the combustion chamber and the mixing means 19 tend to cool. Conversely when the rate of burning is accelerated their temperatures increase. The temperatures of the combustion chamber 7 and mixing means 19 thus vary relatively and together. Since the temperature of the heated air in the passage 26 is directly responsive to the heat of the combustion chamber 7 it is apparent that this temperature also varies directly with the temperatures of the combustion chamber 7 and mixing means 19.

With the thermostatic switch unit 58 adapted to close the circuit of the combination unit 53 when the temperature of the mixing means 19 is at about 200° F., the bi-metal 85 is of a construction such that it will close the valve 84 when the temperature of the mixing means 19 decreases to something above 200° F. or about 240° F. In one commercial embodiment of the invention this temperature of 240° F. corresponds to a temperature of about 150° F. of the heated air in the passage 26. That is to say when the valve 84 closes it denotes a temperature of the heated air of less than about 150° F. and a temperature of the mixing means 19 of approximately 240° F. or less. There is thus a spread of about 40° F. in the temperature of the mixing means 19 between the closing of the valve 84 and the action of the thermostatic switch unit 58 to operate the combination unit 53. By virtue of this difference in the operating temperature of the bi-metal 85 and the thermostatic switch unit 58, sufficient time is permitted to provide for a maximum scavenging action in the combustion chamber 7 when the unit 53 is operated during normal heater operation.

It is apparent, of course, that when the heater is initially started the valve 84 will be closed so that a maximum scavenging action in the combustion chamber 7 will be produced immediately on closing of the main control switch 67. Thus at both the starting of operation, and in the normal operation of the heater, ignition takes place while a condition of maximum scavenging action exists within the combustion chamber 7. Although the heating unit 53 is illustrated and has been described as being a combination unit, it is to be understood that separate heating means and ignition means may be used within the scope of this invention. It is apparent also that the intermittent operation of the ignition means can be in response to the temperature of the air and fuel mixture, to the temperature of the heated air in the passage 26, or to the temperature of the combustion chamber, with the thermostatic means 58 for controlling the operation thereof merely being adjusted relative to the bi-metal switch 85. Where a series wound motor is not utilized it is obvious that thermostatic means operable with the bi-metal 85 may be used to operate a suitable resistance control in the motor circuit to regulate the motor speed.

The invention, therefore, provides a heater of internal combustion type in which the danger of explosion resulting from operation of the ignition means either at the start of heater operation, or intermittently during the normal operation thereof, is completely eliminated. Burning is always initiated smoothly and without objectionable noises so that the heater can be operated in close proximity to the space being heated, or in such space, without discomfort to persons within the space.

Although the invention has been described with specific reference to a single embodiment thereof it is to be understood that it is not to be so limited since parts thereof may be relatively arranged and modified in a manner which is within the full intended scope of this invention as defined by the appended claims.

I claim:

1. An air heating system of internal combustion type including a combustion chamber and a passage for air to be heated in thermal relation therewith, air and fuel mixing means operatively associated with said combustion chamber, electrical means for heating said mixing means to condition the air and fuel therein for burning, means for igniting the mixture from said mixing means, means supplying air to said mixing means, means supplying fuel to said mixing means, with said supply air acting to scavenge said combustion chamber, a circuit for said ignition and heating means including first thermostatic means responsive to the temperature of said mixing means to control the energization of said circuit, and means for varying the quantity of air delivered by said air supply means including other thermostatic means responsive to the temperature of the air in said passage, with said latter means providing for a maximum delivery of air by said air supply means when said circuit is energized.

2. In a heating system of internal combustion type including a combustion chamber, air moving means for supplying air to said combustion chamber, means for supplying fuel to said combustion chamber, means for heating said air and fuel to at least a fuel vaporizing temperature to mix the same together, means in said combustion chamber for igniting said mixture, with said supply air acting to scavenge said combustion chamber, a circuit common to said

ignition means and heating means including first thermostatic means responsive to the heat of said air and fuel mixture to control the energization of said circuit, a passage for air to be heated in thermal relation with said combustion chamber, said air moving means circulating air through said passage, a series wound motor for operating said air moving means, valve means in said passage for closing the same, second thermostatic means responsive to the heat from said combustion chamber to operate said valve means, with closing of said valve means by said second thermostatic means reducing the load on said air moving means whereby said motor increases in speed to increase the speed of operation of said air moving means and the scavenging action in the combustion chamber by the supply air, said second thermostatic means retaining said valve means closed when said first thermostatic means is in a position providing for the energization of said circuit.

3. A heating system of internal combustion type including a combustion chamber, a passage for air to be heated in thermal relation with said combustion chamber having an outlet, fuel vaporizing means operatively associated with said combustion chamber, means for supplying fuel to said vaporizing means, a fan for supplying air to said vaporizing means, with said supply air providing a scavenging action in said combustion chamber, a fan for circulating air through said passage, a series wound electric motor for operating said air supply and air circulating fans, means for heating said vaporizing means to at least a fuel vaporizing temperature to condition the air and fuel therein, means for igniting the mixture to be burned in said combustion chamber, an energizing circuit for said igniting means including first thermostatic means responsive to the temperature of said fuel vaporizing means to control the operation of said igniting means, valve means at said passage outlet for closing the same, and second thermostatic means for operating said valve means in response to the temperature of the heated air at said outlet, said second thermostatic means retaining said valve means closed when said first thermostatic means is in a position to operate said igniting means, with the closing of said valve means reducing the load on said air circulating fan whereby said motor speeds up to increase the quantity of air supplied to said fuel vaporizing means by said air supply fan and the scavenging action in said combustion chamber.

4. A heating system of internal combustion type having a combustion chamber with an inlet and an outlet, a passage for air to be heated arranged in thermal relation with said combustion chamber, an air and fuel mixing portion operatively associated with said combustion chamber inlet, an air supply chamber for supplying air to said mixing portion, said combustion chamber outlet opening into said air supply chamber, an exhaust conduit portion of larger diameter than said combustion chamber outlet projected within said air supply chamber in co-axial alignment with said combustion chamber outlet but axially spaced therefrom, with the air from said air supply chamber passing into said exhaust conduit portion providing a Venturi action at said combustion chamber outlet to accelerate the flow of exhaust gases therethrough, air moving means for supplying air to said air supply chamber, said air moving means circulating air through said air passage, a series wound electric motor for operating said air moving means, electrical means for heating said mixing portion to condition the air and fuel therein, means for igniting the mixture from said mixing portion, an energizing circuit for said heating and igniting means including first thermostatic switch means responsive to the temperature of said mixing portion to control the energization of said circuit, valve means in said air passage for closing the same, and second thermostatic means responsive to the temperature of the heated air in said passage for operating said valve means, said second thermostatic means retaining said valve means closed when said first thermostatic switch means is in a position to energize said circuit, with closing of said valve means reducing the load on said air moving means whereby said motor speeds up to increase the quantity of air supplied to said air supply chamber by said air moving means, said increased air supply concurrently increasing the Venturi action at said combustion chamber outlet and the quantity of air supplied to said combustion chamber.

5. In a heating system including means defining a combustion chamber having an exhaust outlet, means for selectively starting and stopping combustion in said chamber, air moving means for delivering air to said chamber, means for maintaining said air moving means in operation after combustion in said chamber is stopped, and means responsive to the stopping of combustion in said chamber for increasing the speed of operation of said air moving means, thereby to increase the rate of air delivery to said combustion chamber and thus accelerate the removal of exhaust gases from said combustion chamber.

6. In a heating system which includes means defining a combustion chamber, means defining an air heating passage arranged in heat exchange relationship with said combustion chamber, means for starting combustion in said combustion chamber, temperature responsive means for controlling the rate of air flow through said air heating passage, and air moving means controlled in accordance with the rate of air flow through said air heating passage to deliver a maximum amount of air to said combustion chamber during a combustion starting period and to decrease the rate of air delivery to said combustion chamber after combustion is initiated in said combustion chamber.

7. In a heating system which includes means defining a combustion chamber, means defining an air heating passage arranged in heat exchange relationship with said combustion chamber, means for starting combustion in said combustion chamber, valve means for controlling the volume of air flow through said air heating passage, means for controlling said valve means to increase the volume of air flow through said passage after combustion is initiated in said combustion chamber, and air moving means controlled in accordance with the setting of said valve means to deliver a volume of air to said combustion chamber which varies inversely with the volume of air flowing through said passage, whereby a maximum amount of air is delivered to said combustion chamber during a combustion starting period.

8. In a heating system which includes means defining a combustion chamber, means defining an air heating chamber arranged in heat exchange relationship with said combustion chamber, means for starting combustion in said combus-

tion chamber, air moving means for delivering air to said combustion chamber and said air heating chamber, a motor for driving said air moving means, the load imposed upon said motor by said air moving means varying directly with the volume of air moved by said air moving means and the speed of said motor varying inversely with the load imposed thereon, and temperature responsive means for changing the volume of air delivery to said air heating chamber in the same sense with changes in the temperature of the air traversing said air heating chamber, thereby inversely to change the volume of air delivery to said combustion chamber.

9. In a heating system which includes means defining a combustion chamber, means defining an air heating chamber arranged in heat exchange relationship with said combustion chamber, means for starting combustion in said combustion chamber, air moving means for delivering air to said combustion chamber and said air heating chamber, a motor for driving said air moving means, the load imposed upon said motor by said air moving means varying directly with the volume of air moved by said air moving means and the speed of said motor varying inversely with the load imposed thereon, and means for increasing the volume of air delivery to said air heating chamber after combustion is started in said combustion chamber, thereby to provide for the delivery of a maximum volume of air to said combustion chamber during a combustion starting period and for the delivery of a decreased volume of air to said combustion chamber after combustion is started in said combustion chamber.

10. In a heating system which includes means defining a fuel combustion chamber, fuel supply means for said combustion chamber, ignition means for igniting fuel in said combustion chamber, air supply means for supplying air to said combustion chamber and for supplying air to the outside of said combustion chamber to remove heat therefrom, a motor for driving said air supply means, control means for rendering said fuel supply means and said ignition means inoperative, and means for reducing the load on said air supply means after said fuel supply and ignition means have been rendered inoperative, said motor having the characteristic of increasing its speed upon the reduction of the load on said air supply means and the increased motor speed having the effect of accelerating the movement of air to said combustion chamber to remove exhaust gases therefrom.

11. An air heating system including in combination, heat producing means having an air inlet, means enclosing said heat producing means to provide an air passage therebetween having an outlet, movable valve means for closing the outlet from said passage, thermostatic means for operating said valve means to variably close the outlet from said passage in response to a decrease in the temperature of the air traversing said passage, and air moving means for supplying air to said air inlet and said air passage, said air moving means including a motor having operating characteristics such that the speed thereof varies inversely with the load thereon, whereby the speed of said motor is increased to accelerate the delivery of air to said air inlet and the transmission of air through said heat producing means in response to the reduction of the load on said motor which occurs in response to closure of said air passage outlet by said valve means.

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