Feb. 5, 1957 A. C. ALLEN 2,780,280

COMBUSTION HEATER OF THE FUEL VAPOR GENERATOR TYPE

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Fig. 2.

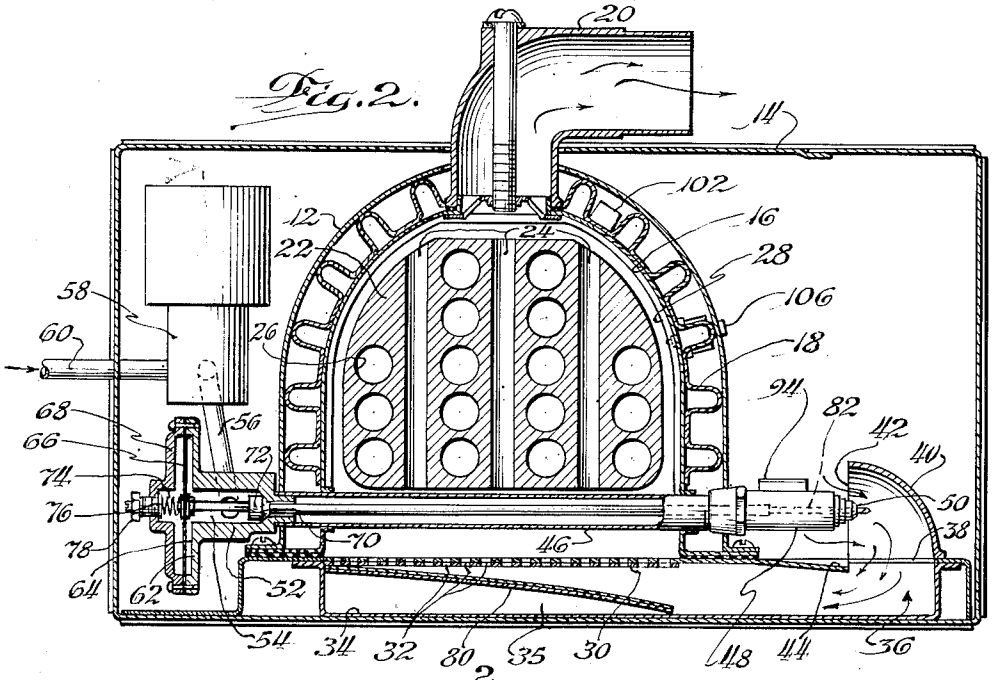
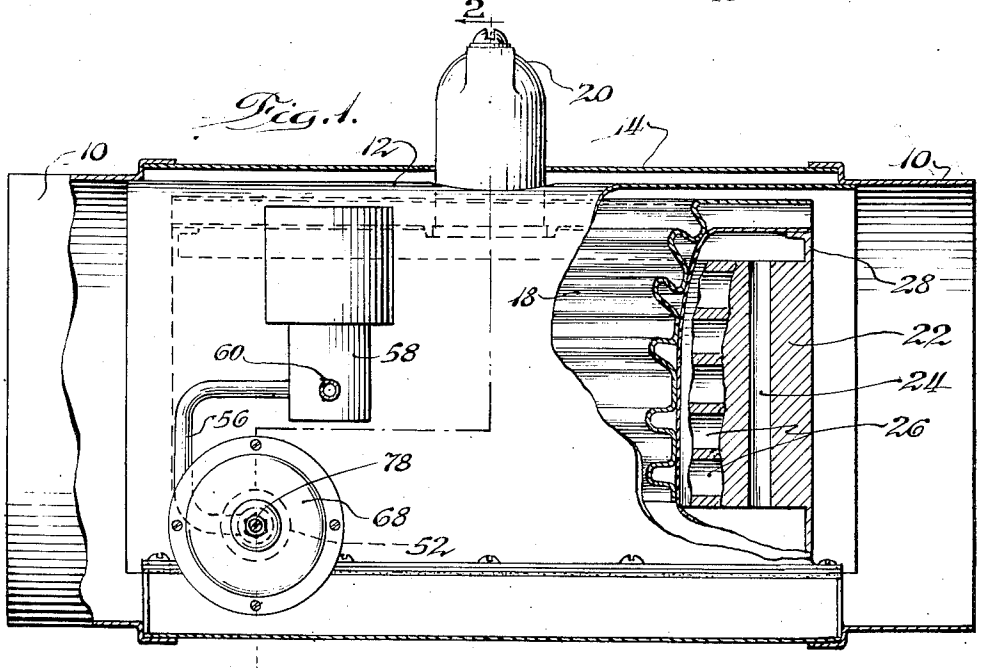


Fig. 1.



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Fig. 3.

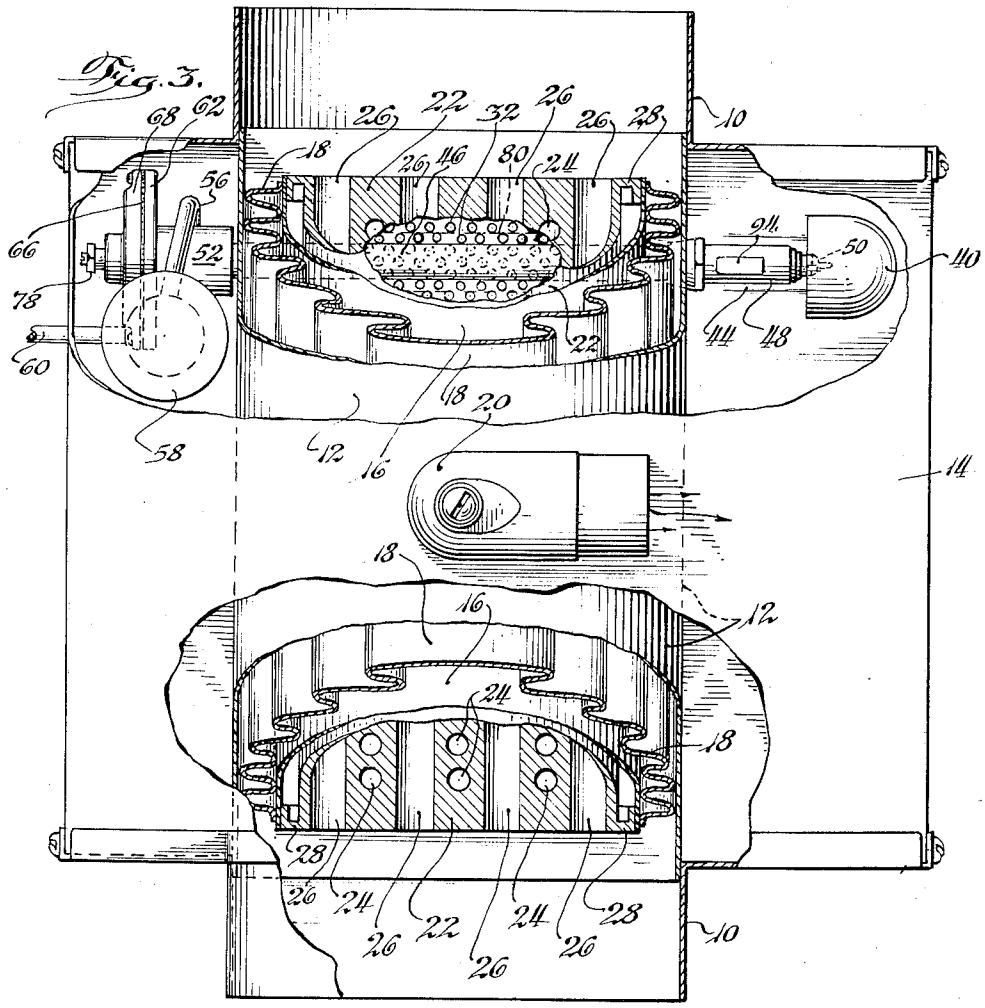
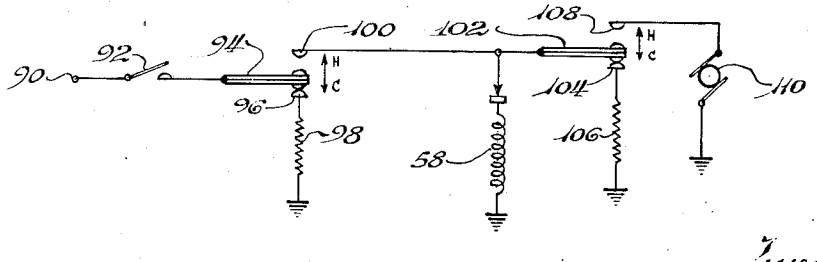


Fig. 4.



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COMBUSTION HEATER OF THE FUEL VAPOR GENERATOR TYPE

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Application August 14, 1952, Serial No. 304,247

3 Claims. (Cl. 158—53)

The present invention relates to combustion heaters of the generator type and more particularly an improved heater of this character which is well adapted for operation as a vehicle heater, although the invention is not limited to any such application.

One of the objects of the present invention is to provide a novel heater of the generator type having a control system which is extremely simple in its operation and requires the use of a minimum of control elements consistent with the control functions to be accomplished.

Another object is to provide a heater of this general character which can be manufactured at relatively low cost.

Yet another object is to provide a generator type heater with a novel arrangement for automatically throttling the heater in the event that it tends to overheat.

Still another object is to provide a novel heater having in general the characteristics set out above with an improved mechanism for automatically maintaining the temperature of the heater relatively constant under all conditions.

Still another object is to provide an improved generator type heater suitable for operation at the ordinary low voltage available on automotive vehicles.

Other objects and advantages will become apparent from the following description of a preferred embodiment of my invention which is illustrated in the accompanying drawings.

In the drawings, in which similar characters of reference refer to similar parts throughout the several views,

Fig. 1 is a longitudinal sectional view through the heater with portions thereof broken away to different levels to illustrate the structure;

Fig. 2 is a vertical transverse view which may be considered as taken in the direction of the arrows substantially along the line 2—2 of Fig. 1;

Fig. 3 is a horizontal view taken from above the heater and showing portions of the structure broken away to reveal the interior of the mechanism at several planes; and

Fig. 4 is an electrical circuit diagram which forms a portion of the heater of the present invention.

Referring to Fig. 1 of the drawings, the heater there shown is equipped at each end with adapters 10 which are generally cylindrical and are intended to be connected into ventilating air duct work so that ventilating air in the duct work passes through the heater mechanism. Although it is not shown excepting in the circuit diagram, a conventional electric fan or blower preferably is located somewhere in the duct work for the purpose of circulating air therethrough to the space to be heated.

The two adapter members 10 connect to the ends of a generally D-shaped sheet metal duct 12 which lies within a rectangular sheet metal box or housing indicated generally by the numeral 14. If desired the ends of this box may be formed as portions of the adapters 10.

The D-shaped duct section 12 serves as a heat exchanger air shroud and is spaced from and encloses a similarly shaped sheet 16 which serves to confine the products of combustion. The D-shaped sheet metal members 12 and 16 are positioned relative to each other by a corrugated

sheet 18 located between the two which has considerable surface contact with the interior sheet 16 and therefore serves to extend this surface for heat exchange purposes. In other words it accomplishes much the same purpose as fins secured to the interior shell 16.

This interior combustion gas confining sheet 16 is connected at a top central point to an elbow fitting 20 which serves to conduct the exhaust to the outside, it being anticipated that this fitting will be connected to an exhaust pipe leading to some remote point.

The space within the interior case 16 is nearly filled by a block of metal such as aluminum having good heat conducting properties. It may be formed as a casting and has a plurality of holes 24 extending vertically therethrough and a second group of holes 26 which extend therethrough in a horizontal end to end direction. The holes 26 and 24 are staggered with relation to each other so that they do not intersect. At its ends the casting 22 is provided with flanges 28 which are sealed to the heat transfer sheet 16 so that ventilating air entering one of the adapters 10 flows longitudinally through the holes 26 and also through the space between the sheets 12 and 16. On the other hand hot products of combustion, produced as will appear presently, flow upwardly through the passages 24 and around the sides of the casting 22 and out the exhaust fitting 20 without mixing with the ventilating air.

The bottom of the space defined by the D-shaped sheet 16 is closed by a flat metal plate 30 spaced a short distance below the bottom of the casting 22. This bottom plate 30 is provided with a multiplicity of perforations 32 through which gas and air mixture passes so as to burn adjacent the upper surface. The openings 32 are sufficiently small so that the perforated plate acts to prevent the flame from flashing back to the lower surface thereof. Beneath the perforated plate 30 there is a sheet metal member formed as a shallow pan 34 which at its upper edges is sealed to the plate 30 so as to form a plenum chamber 35 through which a gas and air mixture can be passed to all of the perforations 32. The plate 30 and the pan 34 extend well to one side of the D-shaped housing 12 as indicated at 36. In this position 36, to one side of the combustion chamber, the plenum chamber top closure member, that is, the sheet 30, is provided with an opening 38 covered by a hood 40 which has an entrance opening 42 in a vertical plane faced toward the burner and heat exchanger portion of the device. Preferably the sheet 30 is depressed slightly to form a trough 44 just in front of the entrance 42 so that as will appear presently if any liquid fuel drips from the fuel nozzle, this fuel will be caught by the trough 44 and channeled into the plenum chamber where it will vaporize and be passed to the burner plate.

A generator tube 46 extends from side to side directly across the space between the bottom of the casting 22 and the perforated burner plate 30 so that this tube is heated by a portion of the flame which is rather generally distributed over the entire upper surface of the perforated sheet 30. The number, size and arrangement of perforations 32 directly beneath the tube 46 may be somewhat different than those through the remaining portion of the sheet if it should be determined that more or less heat is advisable upon the generator tube 46. In other words, the generator tube 46 should be subjected to whatever amount of heating is necessary to readily vaporize all of the fuel being fed to the heater during its operation.

One end of the generator tube 46 is in alignment with the opening 42 in the hood 40 and carries a fitting 48 at one end with the other end of the fitting projecting slightly through the opening 42 into the mouth of the hood. This outlet end of the fitting 48 is drilled to provide a nozzle

50 such that vapor flowing therethrough into the hood 40 will aspirate air, thereby causing a combustible gas and air mixture to flow downwardly through the openings 38 into the plenum chamber 35 and eventually through the multiplicity of openings 32 into the combustion chamber of the heater. The portion of the fitting 48 between the end of the generator tube 46 and the nozzle 50 includes an electric heating element and has a passage therethrough connecting the generator tube 46 and nozzle 50. When the electric heating element is energized, the temperature of the fitting 48 will be sufficiently elevated comparatively quickly so that any liquid fuel flowing into the passage in the fitting 48 will be heated and issue from the nozzle 50 as vapor. This heating element, the circuit for which will be discussed presently, is for the purpose of starting the heater.

The opposite end of the generator tube 46 projects from the opposite side of the heat exchanger and is connected to a valve fitting 52 which has a chamber 54 therein connected in turn by a length of tubing 56 to a low pressure fuel pump 58 which is kept supplied with fuel by a line 60. The end of the fitting 52 away from the heat exchanger has an enlargement 62 with a shallow recess 64 therein in communication with the chamber 54. This recess is covered by a flexible diaphragm 66 sealed and maintained in place around its periphery by a concave cap 68.

Diaphragm 66 is connected at its center to a valve stem 70 which has an enlargement forming a valve closure member at 72 which acts against a seat at the outlet of the valve chamber 54 so that communication between the chamber 54 and the generator tube 46 is greatly restricted when the valve stem 70 is moved to the end of its stroke toward the right as seen in Fig. 2. The valve 72 does not provide a complete seal, however, even in its closed position, since limited communication between the valve chamber 54 and generator tube is desirable under all conditions as will appear presently. When the diaphragm 66 and valve stem 70 are moved toward the left, communication between the valve chamber 54 and the generator tube is substantially unrestricted. In order to insure that the valve 72 will close when the heater is idle, a coil spring 74 bears against the left hand side of the diaphragm 66 and urges the diaphragm and valve stem 70 toward the right. The pressure exerted by the spring 74 may be adjusted by turning a screw abutment 76 which is threaded through the center of the cap 68 and locked in place after adjustment by a locknut 78.

The fuel pump is of the electrically energized type which shuts off flow therethrough when deenergized and which maintains a substantially constant pressure on the fuel at the pump outlet connection at relatively low pressure when the pump is energized.

Within the plenum chamber 35 and in a position directly beneath the generator tube 46 a comparatively stiff bimetal member 80 is fixed with its base end attached to the bottom plate 30 at the side of the base plate toward the valve fitting 52. When this bimetal member is cool, it curves downwardly as shown in Fig. 2, so as to provide very little if any restriction against the passage of the gas and air mixture upwardly through the openings 32 which are directly beneath the generator tube 46. On the other hand, as the temperature of the bimetal strip 80 increases, it flexes upwardly toward a position flat against the bottom surface of the plate 30, thereby closing off the row of perforations 32 directly beneath the generator tube 46. In this last position the gas and air mixture can pass upwardly through all the perforations 32 over the surface of the sheet 30 within the combustion chamber, excepting for those perforations which lie beneath the generator tube 46.

The valve stem 70 extends beyond the valve closure member 72 and on through the generator tube 46 and into the fitting 48. At its extreme end it is equipped with a pin 82 which extends into the nozzle opening of nozzle 50 so as to form a close fit therewith. If desired, the pin 82 may be spirally fluted much like a twist drill, although a smooth pin has been found satisfactory for the purpose. As will be pointed out presently in connection with the discussion of the operation of the heater, the diaphragm 66 moves from one position to another during operation of the heater, and this movement is communicated by means of the valve stem 70 to the pin 82 such that the pin 82 will be thrust into the nozzle opening 50 frequently, thereby clearing away any carbon or gum formation which otherwise might accumulate.

The heater includes the electric circuit shown in Fig. 4 which has a terminal 90 to be connected to the automobile battery or other source of electric power, the other side of which is grounded. The terminal 90 is connected to an on-off heater switch 92 connected in turn to a snap acting, single pole, double throw, thermostatic switch 94 indicated in Fig. 2 in heat conducting relationship to the electrically heated vaporizer fitting 48. When the thermostatic switch 94 is cold it makes an electric circuit with a contact 96 leading to the electric heater element 98 of the vaporizer heater previously mentioned. The other side of this heater element 98 is grounded. When the thermostatic element 94 reaches a predetermined high temperature it snaps away from the contact 96 and into engagement with a second contact 100 which is connected to the ungrounded terminal of an electric fuel pump 58 and also to a second snap acting, single pole, double throw thermostatic switch element 102 shown in Fig. 2 as being in contact with the heat exchanger at a point near the top thereof and therefore sensitive to its temperature.

When the thermostatic switch 102 is cold it makes circuit with a contact 104 connected in turn with an igniter 106 of the hot wire incandescent type, the other side of which is grounded. The location of this igniter 106 is best seen in Fig. 2. When the temperature of the switch 102 has been elevated to a level indicating satisfactory operation of the heater, it snaps the member 102 out of engagement with the contact 104 and makes circuit with the alternative contact 108 connected to an electric motor 110 the other side of which is grounded. This electric motor is for the purpose of driving the fan or blower which circulates ventilating air through the duct work leading to the heater adapters 10. It may be at any point in the ventilating air duct work system and may be of entirely conventional construction.

The heater functions in the following manner. When the heater switch 92 is closed, electric power is supplied to the thermostatic switch blade 94 and by way of contact 96 to the vaporizer heater element 98. After an interval of time, depending upon the characteristics of the vaporizer element and the heater therefor, the temperature of this element will have reached a level where the liquid fuel flowing thereto will be vaporized. Shortly after this temperature has been reached, the thermostatic element 94 will snap out of engagement with contact 96 and into engagement with contact 100. This deenergizes the vaporizer element 98 and starts the fuel pump 58 and energizes the igniter 106. The igniter will reach ignition temperature in a matter of ten seconds or so during which period fuel will have been pumped into the valve passage 54 and this fuel will flow at a reduced rate around the substantially closed valve 72 and into the vaporizer tube 46 and soon will reach the hot vaporizer fitting 94.

As soon as fuel strikes the hot vaporizer, it flashes into vapor thereby increasing the pressure within the generator tube 46. As the pressure within the generator tube 46 rises, this pressure soon becomes greater than that prevailing within the valve chamber 54, with the result that vapor flows backwardly through the leaking valve 72 and raises the pressure within the valve chamber 54 sufficiently to move the diaphragm 66 slightly toward the left. As soon as this occurs, fuel at a greater rate flows from the valve chamber 54 past the valve 72 into the generator

tube 46 and hence to the hot vaporizer 48. Meanwhile, of course, vapor is issuing from the nozzle 50 and aspirating air through the opening 42 in the hood 40, and the mixture thus formed passes downwardly and rearwardly through the plenum chamber 35 and thence upwardly through the perforations 32 into the combustion chamber. As soon as this vapor and air mixture reaches the igniter 106 it is ignited and the flame travels downwardly so as to burn closely adjacent the upper surface of the plate 30.

The flame thus produced quickly elevates the temperature of the generator tube 46 so that as additional fuel flows from the valve chamber 54 to the generator tube 46 it is vaporized therein and passes through the nozzle opening 50 so as to continue operation even though the vaporizer fitting 48 cools after a short interval of time.

As combustion continues, the heat exchanger sheet 16 will rise in temperature until the thermostatic element 102 snaps out of engagement with the contact 104 and into engagement with contact 108. This deenergizes the igniter and starts the ventilating air fan 110 so that air to be heated is circulated through the heat exchanger. Throughout the operation of the heater there will be a slight hunting effect in the generator which is produced by the pressure within the vaporizer tube 46 rising so as to move the diaphragm 66 toward the left momentarily, thereby permitting a quantity of fuel to flow past the valve member 72 and into the generator tube 46. The increase in the pressure within the chamber 54 thus brought about stops delivery of fuel to the chamber by the pump 58 momentarily until the fuel thus permitted to flow into the generator tube 46 has been largely consumed in the event that the vapor pressure is above the pump delivery pressure. When the pressure upon the diaphragm 66 declines, the valve 72 moves into closed position, whereupon the pump 58 refills the chamber 54 and the cycle is repeated.

As the temperature within the heater rises, heat is communicated to the base plate 30 by conduction and by radiation so that its temperature in turn rises and this increase in temperature is communicated to the bimetal element 80. If the heater, therefore, has any tendency to get too hot, the bimetal element 80 increases in temperature and flexes upwardly so as to partially close the perforations 32 immediately thereabove. This reduces the amount of fuel and air mixture flowing through the perforations directly beneath the generator tube 46 and therefore the combustion in this region becomes less and the temperature of the generator tube 46 falls. This reduces the pressure within the generator tube 46 with the result that the diaphragm 66 moves toward the right and remains in this position so that no additional fuel is added to the generator tube 46 excepting that which leaks around the valve 72 when it is in closed position. The heat output of the heater therefore drops to a minimum until such time as the temperature of the bimetal blade 80 falls sufficiently to cause it to deflect away from the base plate 30 to a great enough degree to restore the flame beneath the generator tube 46. This causes an increase in pressure within the generator tube sufficiently to again move the diaphragm 66 toward the left and restore the heater to full heat output operation. The heater, therefore, cannot overheat and it is also apparent that slight movement of the bimetal blade 80 back and forth will insure the heater operating at a substantially constant temperature. Whenever the fuel pump 58 is deenergized, the fuel remaining in the system, which is mostly in vapor phase, will be quickly consumed, thereby extinguishing combustion within the heater and ending the cycle of operation.

Having described my invention, what I claim as new and useful and desire to secure by Letters Patent of the United States is:

1. In a combustion heater of the generator type, means providing a burner plate having a multiplicity of passages therethrough, said passages forming a pattern covering an extensive area, means for supplying a vapor and air mixture to one side of said plate for passage through said passages, means for igniting said mixture at the other side of said plate, said vapor supplying means including a vapor generator of the heat absorbing type positioned on said other side of said plate and positioned to be heated by combustion of the vapor and air mixture passing through a minor portion of the whole pattern of said passages, a heat exchanger including passage means communicating with and heated by combustion of the vapor and air mixture passing through substantially all of said passages, means sensitive to the temperature of said heat exchanger and operative to reduce the flow of vapor and air mixture through said minor portion of said pattern without substantially affecting flow through the remaining portion of said pattern upon a rise in temperature of said heat exchanger above a predetermined value, the last said means including a bimetal strip on said one side of said plate in coextensive relation with said minor portion of said passages, said strip being adapted to deflect toward said plate when heated to reduce flow through said minor portion of said passages.

2. In a combustion heater of the generator type, means providing a burner plate having a multiplicity of passages therethrough, said passages forming a pattern covering an extensive area, means for supplying a vapor and air mixture to one side of said plate for passage through said passages, means for igniting said mixture at the other side of said plate, said vapor supplying means including a vapor generator of the heat absorbing type positioned on said other side of said plate and positioned to be heated by combustion of the vapor and air mixture passing through a minor portion of the whole pattern of said passages, a heat exchanger including passage means communicating with and heated by combustion of the vapor and air mixture passing through substantially all of said passages, means sensitive to the temperature of said heat exchanger and operative to reduce the flow of vapor and air mixture through said minor portion of said pattern without substantially affecting flow through the remaining portion of said pattern upon a rise in temperature of said heat exchanger above a predetermined value.

3. In a combustion heater of the generator type, means providing a generator burner having a major flame port area and a minor flame port area, means for supplying a vapor and air mixture to said burner, said vapor supplying means including a vapor generator of the heat absorbing type positioned to be heated principally by the flame from said minor flame port area of said burner, a heat exchanger including passage means communicating with and heated by the flame from substantially all the flame port area of said burner, means sensitive to the temperature of said heat exchanger and operative to reduce the flow of vapor and air mixture through said minor flame port area of said burner without substantially affecting flow through the remaining flame port area of said burner upon a rise in temperature of said heat exchanger above a predetermined value.

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