United States Patent

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[54] **GAS RANGE BURNER ASSEMBLY**
12 Claims, 2 Drawing Figs.

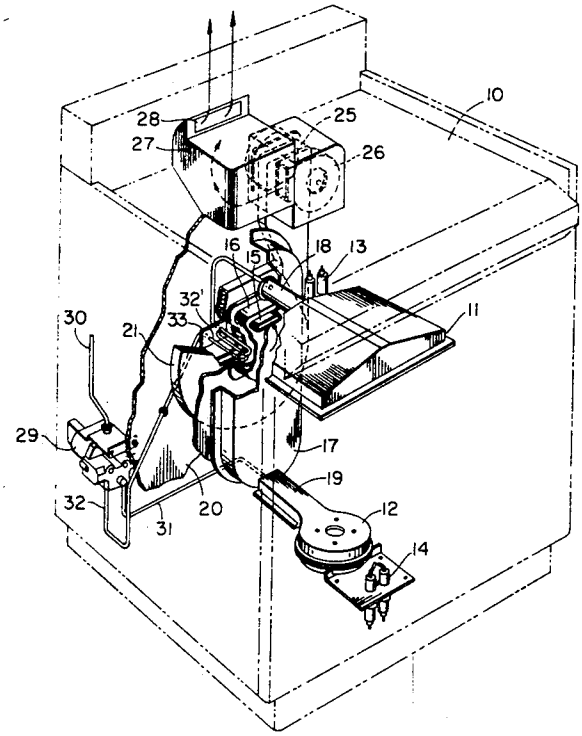
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ABSTRACT: The gaseous fuel as it is delivered to the burner is heated to expand the same and compensate for expansion of the combustion air which occurs and alter the gas-air ratio. In an oven with a heat exchanger, in which air supplied to the oven burner and the oven exhaust are brought into heat transfer relation, the exhaust is directed over a heat section in the fuel line to the burner to effect the desired fuel temperature rise.



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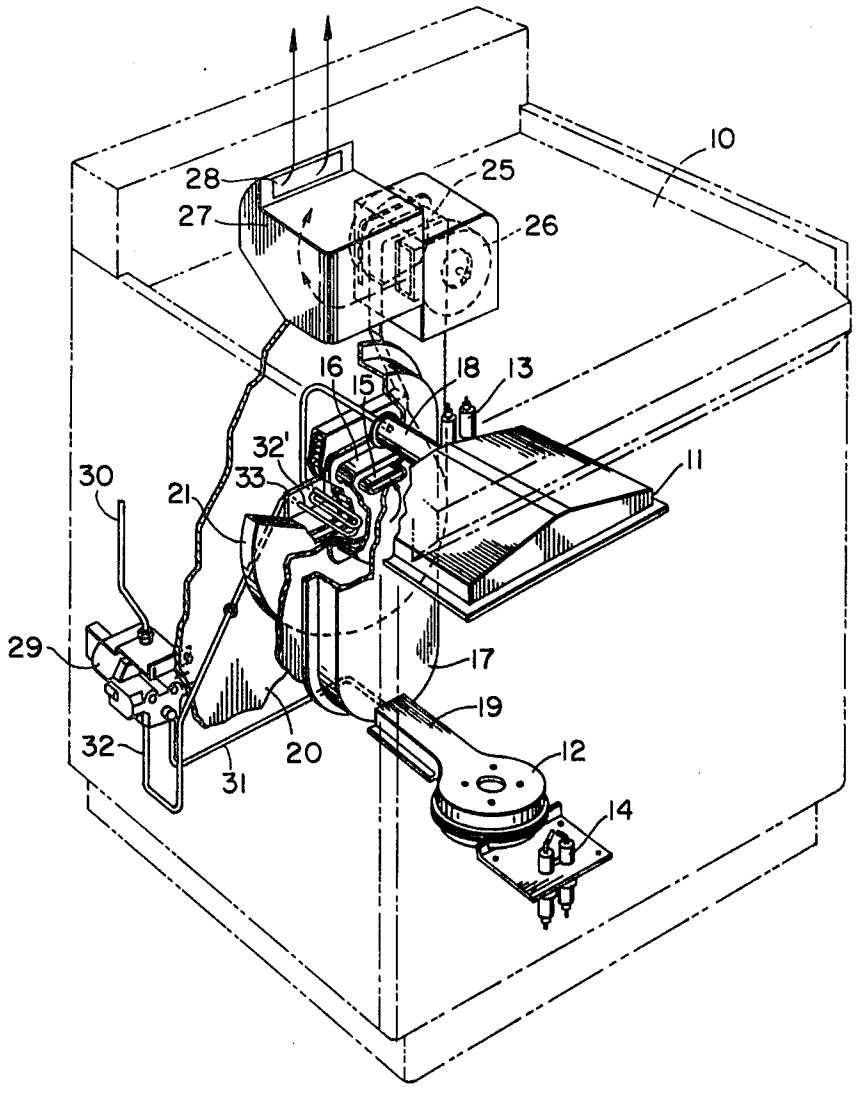


FIG. 1

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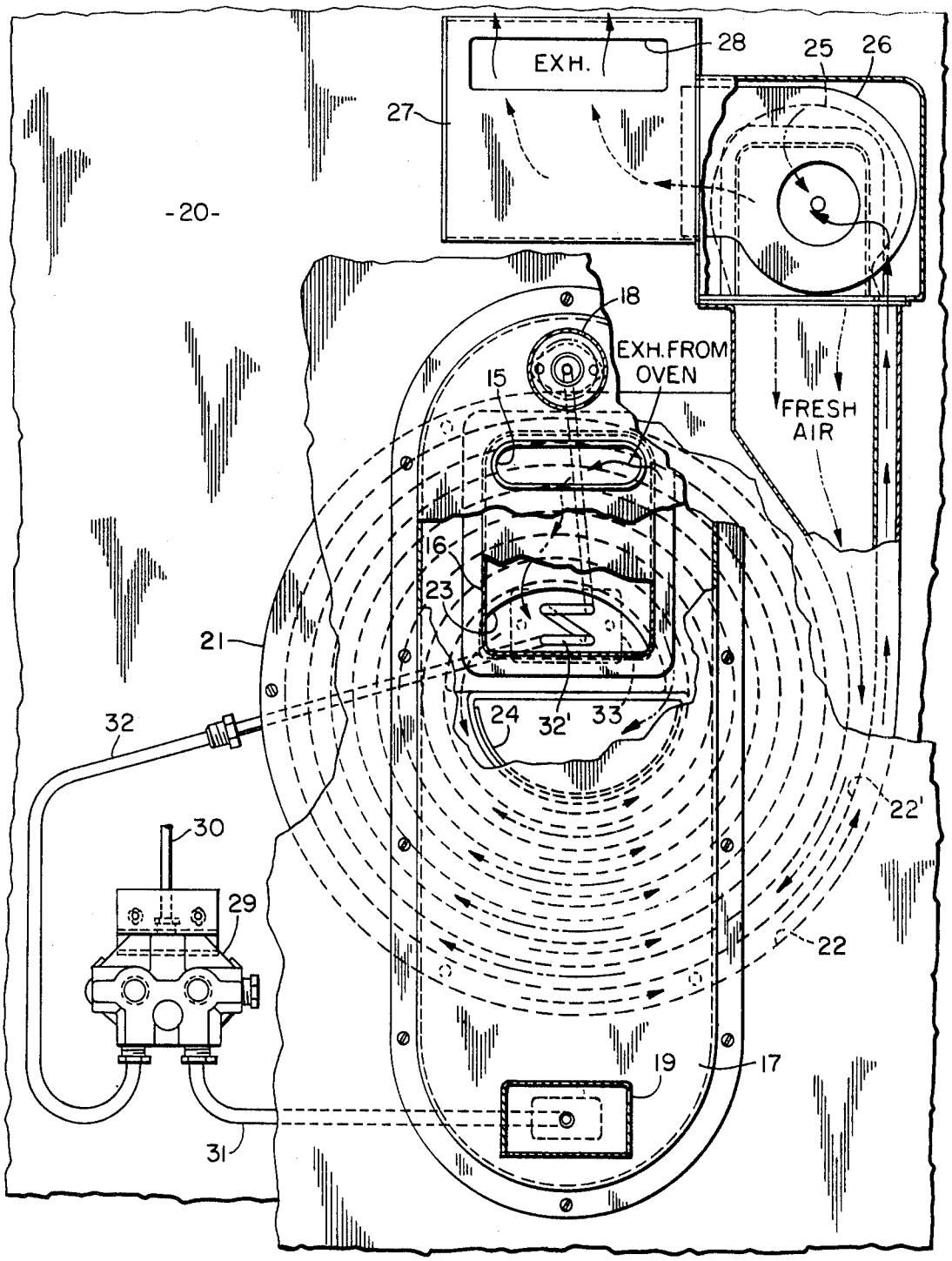


FIG. 2

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GAS RANGE BURNER ASSEMBLY

This invention concerns gas range burners, particularly of the type powered by supply of the combustion air under pressure as well as the gaseous fuel, and the firing of such burners.

There are range applications for such burners in which the supply air becomes significantly heated as a result of operation of the burner, either by design or unavoidably, and the resulting expansion-reduction in the weight of the air mixed with the fuel causes the mixture to become relatively rich. Since this condition could be hazardous, some compensation should be provided, and the obvious answer would be to adjust the starting ratio, that is, upon ignition at room temperature, for supply of excess air in an amount that will be more than enough to offset the loss through heating. The mixture in this case must ignite "hard" or while quite lean, and the excess of cold (room temperature) air extends the heating-up period.

The present invention provides another and much more advantageous solution by regulating the firing of the burner so that the mixture is initially rich and the weight of the fuel is restricted in the operation of the burner. In a reversal of the above-described approach, the mixture ignites "soft" and the initial heat rate is higher than normal for rapid heating to operating temperature. The efficiency of such operations as broiling and radiant heating more generally can be benefited materially in this respect.

It is also a principal object to provide such a burner assembly which is regulated in an extremely simple and economical manner. The economy of use of the invention is obviously of substantial practical importance, while the simplicity of design is a factor also in the reliability of the control which is exercised.

An additional object of the invention is to provide such a burner assembly in which the regulation is responsive to the heat output of the burner and the operation is self-limiting. The reduction of the rate of heating in response to the operation of the burner, and specifically the environmental heating produced by the same, introduces an inherent safety in the assembly which can, for example, in an oven protect the enamel coating the interior surfaces of the oven liner from overheating. In a range top in which there is a glass support above a radiant heater, as another example, the limiting feature can be utilized to make sure that the temperature of the glass does not exceed the maximum design value.

It is a further object to utilize such a regulated burner in conjunction with a heat exchanger in which the supply air to the burner and the heated products from the same are brought into heat transfer relation for preheating of the former and cooling of the latter. Such a burner and exchanger combination has been applied to self-cleaning oven construction for heating the cavity to a temperature of about 950° F. to eliminate food soil therein while limiting the exhaust to about 250° F., and the burner is regulated to establish and maintain near stoichiometric mixing of the air and fuel. This ratio is initially set by adjustment of the start mixture at room temperature and is maintained by proportionately reducing the fuel supply as the air temperature rises and its weight decreases. Excess air can thus be held to a practical minimum, and this is a very significant factor in holding the exhaust to the indicated low temperature for relatively cool kitchen operation notwithstanding the extremely high cleaning temperature within the oven.

Other objects and advantages of the present invention will become apparent as the following description proceeds.

To the accomplishment of the foregoing and related ends the invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawing setting forth in detail a certain illustrative embodiment of the invention, this being indicative, however, of but one of the various ways in which the principle of the invention may be employed.

In said annexed drawing:

FIG. 1 shows in a simplified and partially fragmented perspective the burner system of a domestic gas oven in which the upper or broil burner assembly is in accordance with the present invention; and

FIG. 2 is a fragmented elevation of such oven system at the rear of the burners on an enlarged scale.

Referring now to the drawings in detail, the dashed outline **10** provides a phantom range environment for the oven system fully shown as comprising a top broil burner **11** and a bottom bake burner **12**. The broil burner, preferably of forced air radiant ceramic type or the equivalent, will of course be arranged to provide radiant energy at the top of the cooking cavity formed by the linear means, not shown, while the bottom burner will be covered by the usual removable oven bottom having slots or other perforations for flow upwardly of the heated products from the burner through the cavity. The burners are shown as equipped for spark ignition respectively by ignitors **13** and **14**.

An oven vent **15** is provided at a rear upper location relative to the cavity and leads to an exhaust duct **16** enclosed within and isolated from a vertically oriented air supply duct **17**. The latter is in communication with both air inlets **18** and **19** for the top and bottom burners, the bake burner as well being designed to operate with the pressurized air supply.

At the rear of the oven wall **20**, there is a stationary heat exchanger **21** of general scroll form and having spiral alternating fresh air and exhaust passages. The inner central end of the exhaust passage **22** communicates with an opening **23** in the exhaust duct **16** which is within the air supply duct **17**, while the also inner central end of the fresh air passage **22'** communicates with a separate discharge opening **24** through the air supply duct **17**. From this center discharge, the air passage **22'** winds spirally outwardly to an air blower **25**, and the exhaust passage **22** extends similarly in alternating turns to an exhaust blower **26**.

The two blowers, which can be driven from a single motor, produce counterflows of the air and exhaust to the burners and from the cavity, respectively, and there is a continuation exhaust duct **27** which carries the heated products to a convenient room outlet **28** located in the backsplasher of the range. The oven controls will be such that both blowers are operative whenever either burner is turned on and, in a working embodiment of this system, the bake burner alone is of course used for baking and roasting operations and the broil burner is used not only for broiling but also for self-cleaning, the latter operation involving heating the oven to a temperature on the order of 950° F. as is well known.

The control of the range is exercised in part through a solenoid operated gas valve **29** to which the gaseous fuel, usually natural gas, is delivered under ordinary pressure through the line **30** and from which the fuel is selectively delivered at the same pressure either to the bake burner through the line **31** or the broil burner through the further line **32**.

The supply line **31** to the top or broil burner **11** includes, however, a special heat section **32'** shown as comprising two loops of the line or tubing and a mounting plate **33**. This section is applied to the regenerator or exchanger **20** so that it is disposed in the passage leading from the oven exhaust ducting **16** to the exchanger and hence is exposed to the exhaust or outflow of the heated products from the oven cavity.

The purpose of this section **32'**, which serves as a regulating device, is to effect a predetermined expansion of the gaseous fuel delivered to the top burner proportional to the temperature in the oven cavity and hence its exhaust. As noted earlier, the air supply to the top burner during broiling or self-cleaning becomes heated by design as a result of the transfer of heat energy between the same and the exhaust within the exchanger, especially during cleaning, to maintain the discharge temperature at a level which can be very readily tolerated within a home kitchen, with the result that the weight of the air delivered for combustion with the fuel decreases and the mixture tends to become relatively rich or soft. This weight loss of air has been fully compensated by the

heating of the gaseous fuel which inheres in the arrangement shown with temperature rise in the oven, and it has been possible to maintain nearly stoichiometric values throughout even the fairly lengthy and high temperature cleaning operation.

More particularly, in a typical clean cycle in an oven operated with natural gas at normal pressure, the broil burner has been operated at an initial rate of 23,200 B.t.u./hour with the oven at a temperature of 120° F. and the temperature of the tube heater section at 115° F. The final burner rate, at the maximum design temperature of 920° F., was 17,250 B.t.u./hour realized with a tube heater section temperature of 550° F. Accordingly, it is not necessary in this system that the powered radiant burner be ignited hard or with excessive air when cold in order to protect against the mixture becoming dangerously rich at the maximum temperature of the oven, and the self-regulating feature is realized obviously without complication or significant added expense. The temperature rise of the fuel is of course matched in this control to the temperature increase of the air to maintain the proper gas-air ratio, but the manner in which the fuel is heated might vary considerably both where the heated products of the burner are used for the purpose and also with different heat sources employed, for example, auxiliary heat inputs. Cost is a factor in this last respect, with the particular configuration or assembly used, however, ensuring that the fuel temperature will experience quickly the desired temperature rise.

Having determined that the reduction in fuel weight would be highly desirable for the noted reasons, the simplicity of the disclosed embodiment will be further appreciated by considering some possible functional alternatives. For example, the air fan capacity could be made to increase as the oven temperature rises, but this would require an automatic motor control. A damper might also be used for increasing the air supply with temperature rise, but this expedient again requires the addition of a temperature sensitive device and mechanical actuation. The disclosed solution, on the other hand, only requires the appropriate matching of the fuel temperature rise relative to the decreasing air supply with constant fan speed and the same fixed orifice.

I, therefore, particularly point out and distinctly claim as my invention:

1. In a gas burner system in which a combustible mixture of a gaseous fuel and air is burned for heating purposes, with the mixture relatively rich at ignition and the combustion air experiencing an appreciable temperature rise following ignition and heating of the burner to operating condition, such that the mixture tends to become increasingly rich, means for compensating for the weight loss of the combustion air resulting from such temperature rise of the same to prevent such increase in the richness of the mixture, said means comprising a source of the gaseous fuel under pressure, fuel supply means extending from said source to the burner to convey the fuel to the latter for combustion, and means for heating the fuel to raise its temperature as it is conveyed by the fuel supply means to reduce the fuel weight proportional to said weight loss in the combustion air supplied to the burner.

2. A gas burner system as set forth in claim 1, wherein said heating means is powered by a portion of the heat produced by the burner.

3. In combination with a gas burner in which a combustible mixture of a gaseous fuel and air is combusted for heating purposes, with the mixture relatively rich at ignition, enclosure means for the burner which becomes heated thereby, a source of the gaseous fuel under pressure, fuel supply means including a delivery line for conveying the fuel from the source to the burner, means for supplying combustion air to the burner with the air experiencing an appreciable rise in temperature in such supply as a result of operation of the burner and the fuel-air ratio as a result tends to become increasingly rich, and means for applying heat to a portion of said delivery line to effect a compensating rise in the temperature of the fuel therein and prevent such relative increase in the richness of the mixture.

4. The combination set forth in claim 3, wherein heat energy within said enclosure means is applied to the heating of said delivery line.

5. The combination set forth in claim 4, wherein said portion of the fuel delivery line is exposed within the enclosure means for the heating of the former.

6. The combination set forth in claim 3, wherein the means for supplying combustion air to the burner includes a blower for delivering the air thereto under pressure.

7. The combination set forth in claim 6, wherein the combustion air in the supply thereof to the burner is brought into heat exchange relation to heated products exhausted from the burner for cooling of such products and preheating of the air.

8. The combination set forth in claim 7, wherein the enclosure means for the burner forms an oven cooking cavity.

9. The combination set forth in claim 8, wherein said portion of the delivery line for the fuel is exposed to exhaust of the heated products from the oven cavity for the heating of the fuel in the supply thereof to the burner.

10. The combination set forth in claim 7, wherein said portion of the fuel delivery line is exposed to the heated products exhausted from the burner prior to the bringing the latter into the heat exchange relation to the combustion air.

11. The method of regulating operation of a burner in which a mixture of a gaseous fuel and air is combusted for heating purposes, with the mixture relatively rich at ignition, and the combustion air in the supply of the same to the burner experiencing an appreciable temperature rise following ignition of the burner and heating of the same to operating condition, whereby the mixture tends to become increasingly rich, which comprises the steps of establishing a source of the gaseous fuel under pressure remote from the burner, heating the fuel in delivery of the same to the burner from said source to reduce the weight thereof in the combustible mixture, and relating such heating of the fuel to the aforesaid heating of the combustion air to compensate for the weight loss of the latter and prevent the noted increase in the richness of the mixture that would otherwise occur.

12. The method set forth in claim 11, wherein a portion of the heat generated by the burner is applied to the heating of the fuel in the delivery of the same to the burner.