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METHOD OF AUTOMATIC CONTROL FOR GAS BURNING APPARATUS

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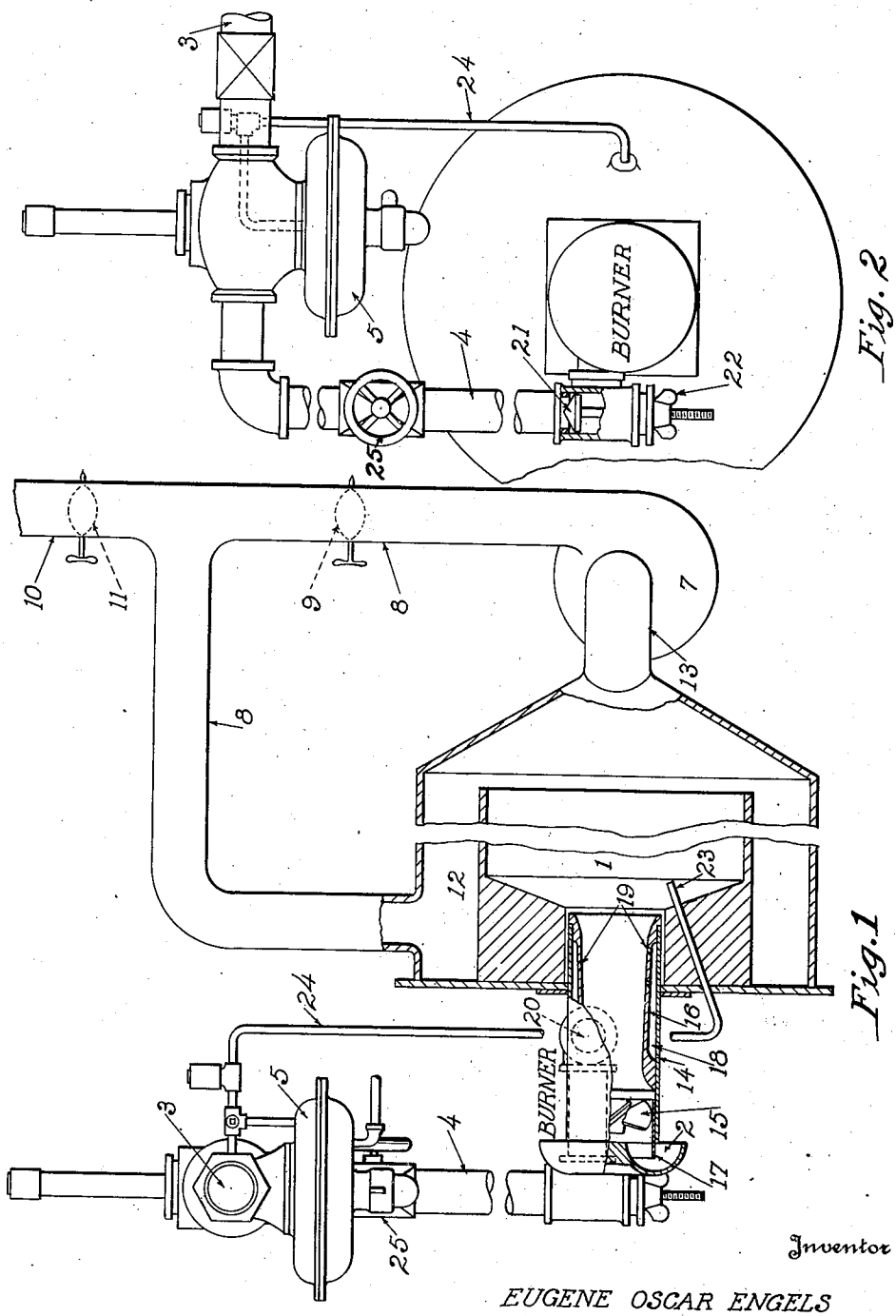

Fig. 2

Fig. 1

Inventor

EUGENE OSCAR ENGELS

By George B. Willcox

Attorney

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METHOD OF AUTOMATIC CONTROL FOR GAS BURNING APPARATUS

Eugene Oscar Engels, Saginaw, Mich., assignor to Baker Perkins Company, Inc., Saginaw, Mich., a corporation of New York

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2 Claims. (Cl. 158—117.5)

This invention relates to gas burning furnaces of the type in which there is an exhaust fan or impeller to create partial vacuum or suction in a combustion chamber and thus draw in gas and air through a mixing burner. The burner supplies fuel mixture continuously and in a predetermined and substantially invariable gas-air ratio, notwithstanding fluctuations of suction, flame magnitude, and furnace duty. Industrial heating systems that use furnaces of this character include bake ovens, enameling ovens and the like.

Objects of the invention are, to prevent gas-air pocketing, back-firing, belching, and explosion;

To cause the burner to send forth appropriately varying volumes of flame by using the suction fluctuations in the combustion chamber as an automatic regulator for the fuel supply;

To prevent any gas from entering the burner and combustion chamber except while there is enough suction in the combustion chamber to overcome a predetermined degree of sub-atmospheric pressure that is permanently maintained in the gas supply at the burner, accomplishing this result automatically and without employing valves or other mechanical shut-off devices;

To scavenge the furnace and heating system by automatically halting the gas flow in the manner stated and circulating fresh air through the passages whenever the degree of partial vacuum in the combustion chamber approaches closely to atmospheric, as for example in starting and shutting down;

To exercise such control without disarranging the optimum gas-air rate for which the burner inlets may have been set, even though the furnace duty were to vary much more widely than is permissible with earlier systems; and

To attain all these desirable results by a novel method that is capable of being carried out with a new combination of known devices, simple to operate, relatively inexpensive, compact and mechanically efficient.

Other objects will appear later in the specification and the method steps and the structural features appertaining to the invention will be recited in the claims. The accompanying drawing shows a preferred embodiment of the invention.

Fig. 1 is a fragmentary side view partly in section showing a furnace embodying my invention, together with a diagrammatically indicated heat circulating system.

Fig. 2 is a view in front elevation of the furnace and burner.

A combustion chamber 1 is provided with a burner adapted to mix gas and air and to discharge the mixture into the chamber. Preferably the burner is of the type known in the trade as a nozzle-burner because it simultaneously completes the mixture, discharges it from the nozzle and gives a long, soft flame that does not damage the furnace lining.

The air supply enters the burner intake 2 at atmospheric pressure.

The primary gas supply for the burner may be any source of gas, say, a service main 3 with a conduit 4 leading to the burner.

A suitable pressure reducer 5 of known construction is installed in the conduit and delivers to the burner a supply of gas which is permanently maintained at slightly below atmospheric pressure, say, in the order of minus two-tenths of an inch, water column.

During the operation of the burner a suction device 7, such as an exhaust fan or impeller, maintains in the combustion chamber a partial vacuum, lower than the previously mentioned slight sub-atmospheric pressure which is maintained permanently at the gas intake of the burner by the reducer 5. The burner stops operating when the suction in the combustion chamber is not lower than that of the gas supplied by the reducer.

Numerals 8, 8 designate the conduits of a heat circulating system and are to be considered as representing ovens, heaters or the like. A flow regulating damper 9, a vent 10 for escape of excess gases, and a damper 11 therein indicate diagrammatically the usual auxiliaries of such a system. An annular jacket 12 may enclose the combustion chamber, communicating at its end with the fan 7 by connector 13.

When damper 11 is closed the passages 8, 8, 12 and 13 provide with the fan a closed circuit, and no suction is then produced in combustion chamber 1 or in the burner even though the fan operates at full speed; but by opening vent 10 more or less at damper 11, a corresponding degree of suction will be created around the burner nozzle. As soon as a very slight amount of suction develops in the combustion chamber fresh air is drawn in through the burner, but no gas, since regulator 5 keeps the gas supply at less than atmospheric pressure. When suction increases, as by wider opening of damper 11, or else by change of fan speed, or by changing damper 9, gas will be released from the somewhat reluctant regulator 5 and mixing starts in the burner at whatever gas-air ratio may have been

determined by the setting of its gas intake and air intake. It will be clear to those skilled in the art that even while the fan is running full speed, adjusting the dampers will result in more or less suction at the burner and that extremely small degrees of suction can be produced, so close to atmospheric that the slight suction, in the order of minus two-tenths inch of water column above referred to as a desirable gas supply pressure, gives ample scope for practical attainment of the desired automatic control and regulation, and further that the arrangement gives extreme sensitiveness of control at unusually low rates of fuel consumption and low furnace duty.

A typical burner structure, shown in Fig. 1, has a tubular shell 14 projecting into the combustion chamber. Fixed air swirling vanes 15 are provided in shell 14 near one end and an air nozzle 16 is fitted in the other end. The shell has a longitudinally adjustable sleeve 17 by which the size of the air intake can be fixed. Air nozzle 16 is formed to present a jacket space 18 for gas, and holes 19 in the wall of the nozzle allow gas to go from the jacket space into the air nozzle. Numeral 20 designates the gas intake to jacket space 18 from gas conduit 4. The flow of gas passing from pressure reducer 5 to the burner is adjustable by valve 21, Fig. 2, and its fastener 22.

A typical pilot light system is shown diagrammatically, 23 indicating the pilot nozzle, and 24 its gas supply pipe. In pipe 4 a shut-off valve 25 is also provided.

The operation is as follows. When the system is to be started the fan is caused to circulate air through the heating system at a rate corresponding to the normal speed of the fan, then if vent 10 is opened so that some of the circulating air can escape, a correspondingly slight suction will develop in the combustion chamber 1, but not sufficient to bring in gas, hence scavenging is effected in the heating system.

If the suction is increased so as to overcome the negative pressure for which the reducer 5 has been set, then gas will enter the burner in whatever quantity is permitted by the setting of valve 21 and air will enter in quantity determined by the setting of sleeve 17, these two adjustments determining the optimum gas-air ratio appropria e to the kind and quality of fuel. When the heating system warms up under the increased temperature of the circulating gases the latter becomes less dense and the suction in the combustion chamber will decrease.

In practice it has been observed that without any change in fan speed the suction at the burner will be half as much at six hunderd degrees Fahrenheit as it was when the circulating gases were at room temperature, so it is seen that when the heating system is at its maximum temperature and less fuel is required to keep it in that condition, then the suction in the combustion chamber will have dropped automatically and in consequence less mixture will be drawn to the burner, yet the optimum gas-air ratio will stay constant. If anything should occur to stop the fan the suction in the combustion chamber will disappear and the pressure therein will become atmospheric, but the gas supply will stop first, the air supply later.

It is now apparent that under no circumstances can gas enter the burner or the combustion chamber or the heating system unless the fan is running and is producing a degree of suction in the combustion chamber that is greater than the degree of negative pressure maintained in the gas supply at the burner. No levers, thermostatic valves or other devices are required to produce that desirable and effective control, and the likelihood of explosion through negligence of the operator is minimized. In the present application claims are directed to applicant's method. Claims to the novel structural features herein disclosed are reserved for a divisional case.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. Method for controlling the supply of fuel to a mixing gas burner, which consists of supplying to said burner air at atmospheric pressure, supplying separately to said burner gas at a predetermined sub-atmospheric pressure, and maintaining pressures around the delivery end of said burner less than said sub-atmospheric gas pressure, thereby drawing gas into the burner to produce a combustible mixture, and varying the said pressures, the range of variation extending from pressures less than the said sub-atmospheric gas pressure at which mixing is produced to pressures greater than the said sub-atmospheric gas pressure but less than atmospheric, whereby mixing is prevented and air alone is admitted to the burner.

2. The method set forth in claim 1 wherein the predetermined degree of sub-atmospheric pressure of the gas is in the order of two-tenths of an inch of water.

EUGENE OSCAR ENGELS.