

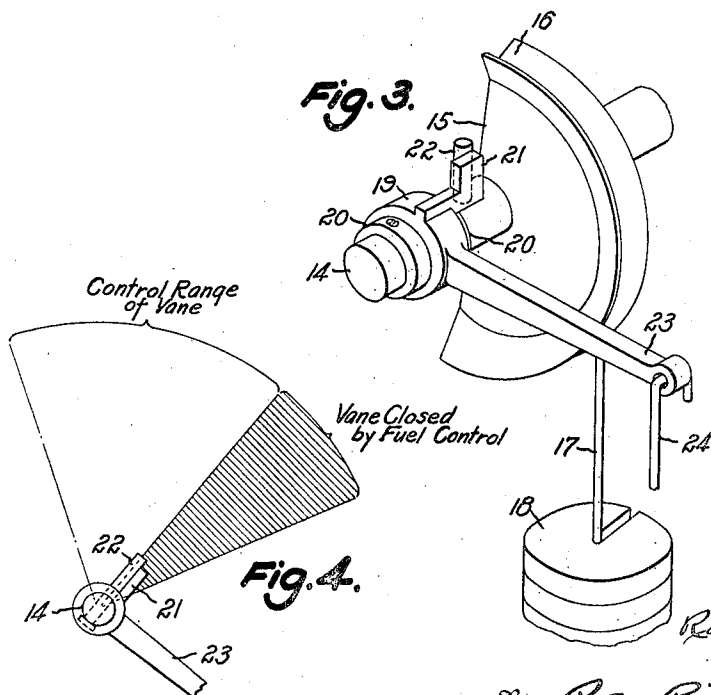
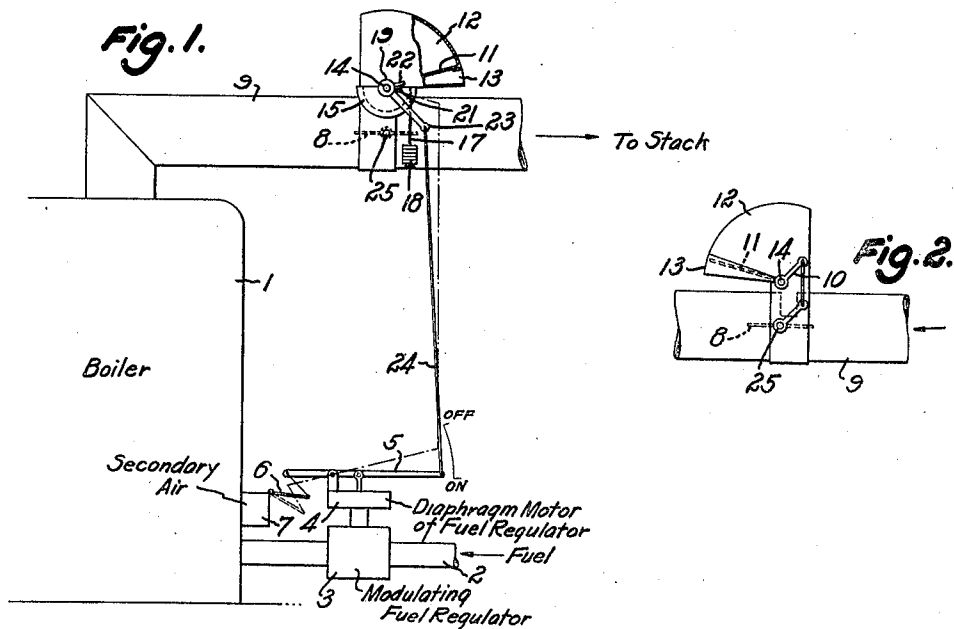
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DRAFT CONTROL FOR COMBUSTION HEATING SYSTEMS

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DRAFT CONTROL FOR COMBUSTION
HEATING SYSTEMS

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3 Claims. (Cl. 236—1)

This invention relates to a draft control for boilers and particularly to a draft control for combustion heating systems and the like having mechanisms for automatically regulating the fuel supply in accordance with the load on the system.

The general purpose of draft controls, whether manual or automatic, is to maintain a constant combustion efficiency and to avoid the loss of heat up the furnace stack. Substantial fuel economies may be effected with a manual control of draft conditions when the boiler load is approximately constant for long periods and atmospheric conditions at the stack outlet are also substantially constant, but a manual control of the draft is not practical under changing wind and temperature conditions or for boilers subject to widely varying steam demands.

An object of the present invention is to provide a draft control for boilers having a modulating fuel regulating device, the control including a damper mechanism that is automatically adjusted by the modulating fuel regulating device to limit the effective furnace smoke pipe opening in accordance with the throttling of the fuel supply and which is operable automatically to effect a further restriction of the effective smoke pipe opening when wind and atmospheric conditions tend to increase the draft.

An object is to provide a draft control including a throttling mechanism such as a damper in the furnace smoke pipe, mechanism for positively moving the damper toward closed position in accordance with changes in the rate of supply of fuel to the furnace, and mechanism automatically operable by smoke pipe draft conditions to effect a further closing movement of the damper when the draft rises above a desired value. More specifically, an object is to provide a draft control of the type stated in which the mechanism for automatically operating the damper includes a vane that is subjected, on its opposite sides, to atmospheric pressure and to the pressure at the boiler side of the damper.

These and other objects and advantages of the invention will be apparent from the following specification when taken with the accompanying drawing in which:

Fig. 1 is a fragmentary side elevation of a gas fired boiler and of draft control mechanism embodying the invention;

Fig. 2 is an elevation of the stack damper and control vane as seen from the side opposite to Fig. 1;

Fig. 3 is a fragmentary perspective view of the vane shaft and the yoke connecting the same to the fuel regulating motor; and

Fig. 4 is a diagrammatic view showing limitation of the range of automatic damper control by the vane when the fuel supply is adjusted to an intermediate value.

In Fig. 1 of the drawing, the reference numeral 1 identifies a boiler to which gas is supplied from a conduit 2 through a modulating fuel regulator 3 that is automatically adjusted by a diaphragm motor 4. The fuel regulator, its motor and the mechanism (not shown) for controlling the motor may be of any known or desired type as the specific construction of these elements forms no part of the invention.

The regulator motor 4 actuates a lever 5 for adjusting the damper or valve 6 of a secondary air inlet box 7 in accordance with the modulated supply of fuel to the boiler combustion chamber. This simultaneous regulation of the fuel and the air supply decreases the variation of combustion efficiency with changes in the fuel supply but will not result in constant or even approximately constant combustion efficiency since draft conditions will affect the air supply to the combustion chamber.

In accordance with this invention, a damper 8 is located in the smoke pipe 9 that extends to the stack, not shown, and the damper is controlled jointly by the modulating fuel regulator and by mechanism responsive to draft conditions in the smoke pipe. The maximum opening of the damper is determined by the fuel regulator but the damper may then be adjusted toward closed position automatically when the draft tends to rise above a desired value.

The damper 8 is connected by a linkage 10, Fig. 2, to a pivoted vane 11 in a chamber 12. The chamber opens into the smoke pipe 9 at the furnace side of the damper, and has an opening 13 to atmosphere at the opposite side of the vane.

Thus, the vane 11 is subjected on one side to the pressure in the smoke pipe 9 on the furnace side of the damper 8 and is subjected on the other side to the pressure of the atmosphere in the vicinity of the furnace.

The term "draft" as used in the specification and claims is used in a technical sense and denotes the pressure drop across the furnace from the atmosphere surrounding the furnace and smoke pipe containing the damper to a point in the smoke pipe between the furnace and the damper.

The shaft 14, to which vane 11 is affixed for rotation, carries integral with it pulley section 15 provided with slot 16. A flexible cord 17 is fixed to the pulley, as best shown in Fig. 3, and this cord supports weights 18. The combined pull of these weights is adjusted to a value dependent upon the difference in pressure desired between the two sides of vane 11 when the furnace system is operating normally at full load.

Vane shaft 14 has mounted on an extension thereof the yoke 19 which is free to rotate upon the shaft but prevented from moving along the shaft by set collars 20. The yoke is provided with an arm 21 which may be brought in contact with a pin 22 fixed to shaft 14 when the yoke is rotated relative to the shaft. The yoke is further provided with an arm 23 which is connected by link 24 with lever 5 actuated by the diaphragm motor 4.

Referring to Fig. 1, as the diaphragm of the motor 4 rises for the purpose of decreasing the amount of fuel fed to the furnace the right-hand end of lever 5 also rises. Link 24 lifts arm 23 of the yoke causing vane 11 to rotate in a counter-clockwise direction which, in turn, through linkage system 10 moves damper 8 to close the latter. If the movement imparted to vane 11 is insufficient completely to close damper 8, it will be seen that the vane is still free to close the damper further under the influence of differential pressure applied to the two faces of the vane. Fig. 4 diagrammatically indicates the vane moved to partially closed position by the fuel control, and shows the control range of the vane still remaining to limit the smoke pipe draft so that it does not substantially exceed the value pre-selected for normal full load operating conditions.

Instead of yoke 19 being mounted on vane shaft 14 as shown, it may be similarly mounted on damper shaft 25 in which case the latter is provided with a pin similar to the pin 22 of shaft 14. Movements of the motor diaphragm are then more directly transmitted to the damper. Vane 11 rotates with damper 8 because of the linkage 10 connecting the two.

The degree of rotation of damper 8 under the influence of movements of lever 5 may be varied by including in the linkage system 24 suitable cams, gears or the like to set the damper in its optimum position for any fuel feed rate. These conditions will differ somewhat in different installations.

It will be seen that the pin 22 and arm 21 of yoke 19 together provide a stop mechanism to limit the maximum opening of the damper 8 in accordance with varying rates of supply of fuel to the furnace. A one-way connection is thus provided in the mechanism connecting the fuel regulating motor with the damper, whereby the damper may be positively and progressively moved toward closed position as the fuel regulating motor progressively decreases the rate of supplying fuel to the furnace. However, as the fuel regulating motor operates to increase the rate of supply of fuel to the furnace, arm 21 is moved away from pin 22 leaving the damper free to open under the influence of draft conditions in the smoke pipe. There is no positive movement of the damper by the fuel regulating motor as the latter operates to deliver more fuel to the furnace.

As the diaphragm of motor 4 rises, the left-hand end of lever 5 is depressed, tending to close the valve 6 which admits secondary air to the

combustion chamber. This is a desirable feature of my system, but not an essential one. The regulation of secondary air may be divorced from the conjoint regulation of fuel and draft, or the secondary air supply may remain fixed for all conditions of operation.

The following brief description of the operation of a furnace heating system according to the present invention will be given by way of example to clarify the working association of the several elements comprising the system. This description is not to be considered as limitative upon the invention but is merely illustrative thereof.

With a furnace system such as shown in the drawing, most efficient combustion with maximum firing was found to take place at a draft of 0.1" as measured across the wall of smoke pipe 9 between the boiler and the damper 8. The weights 18 accordingly were adjusted until the equilibrium position of vane 11 maintained damper 8 in a position such that 0.1" draft existed under normal operating conditions (no wind affecting the stack draft, etc.) at maximum fuel feed. The secondary air valves were adjusted for maximum operation. The diaphragm motor of the modulating fuel regulator was controlled by a thermostat located in the apartment to be heated. The rising temperature in the apartment actuated the thermostat to cause the diaphragm of motor 4 to rise and thereby to reduce the fuel fed to 50% of its full load value. Movement of the diaphragm effected a reduction in the secondary air supplied as previously explained. Lever 5 acting through its associated linkage mechanism partially closed vane 11 to an intermediate position. Damper 8 simultaneously was moved by its linkage system 10 to a position to throttle the flow of furnace gases through smoke pipe 9 thereby reducing the draft to a value of 0.05" under normal conditions, which had been determined to be a suitable draft for 50% of maximum fuel feed. This regulation of draft is strictly mechanical throttling and does not depend on any pressure relationship between smoke pipe and atmosphere.

With this setting, the damper is mechanically restrained to maintain a minimum draft of 0.05" under normal operation. The draft may vary due to changing atmospheric or furnace conditions but it cannot rise above 0.1" for which the automatic draft control mechanism is adjusted. If the draft tends to rise above this value, the pressure drop across vane 11 causes the latter to move damper 8 toward fully closed position to a position where the equilibrium draft of 0.1" is re-established. The draft may drop below 0.05", but in practice such difficulty is rarely encountered.

It will be apparent that the draft control of the present invention provides simple and effective means for regulating furnace draft within narrow limits on furnaces having a modulated fuel supply. Such furnaces may use any fuel, oil, gas, or coal being the most commonly employed combustibles.

I claim:

1. In a combustion heating system, the combination with a furnace, control means for modulating the supply of fuel to the furnace, and an automatic draft control mechanism including a damper in the furnace smoke pipe and damper-actuating means responsive to the draft in the smoke pipe tending to move said damper to maintain the draft at a predetermined value, of

stop means actuated by said control means to limit the opening movements of said damper by said damper-actuating means in accordance with changes in the rate of supply of fuel to the furnace.

2. In a combustion heating system, the invention as claimed in claim 2, wherein said stop means includes a linkage constituting a one-way coupling between said control means and said automatic draft control mechanism.

3. In a combustion heating system, the combination with a furnace, control means for modulating the supply of fuel to the furnace, and an automatic draft control mechanism includ-

ing a damper in the furnace smoke pipe and damper-actuating means responsive to the draft in the smoke pipe tending to move said damper to maintain the draft at a predetermined value,
5 of stop means actuated by said control means to limit the opening movements of said damper by said damper-actuating means in accordance with changes in the rate of supply of fuel to the furnace, and additional means for varying the
10 amount of air admitted to the furnace combustion chamber in accordance with changes in the rate of supply of fuel to the furnace.

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