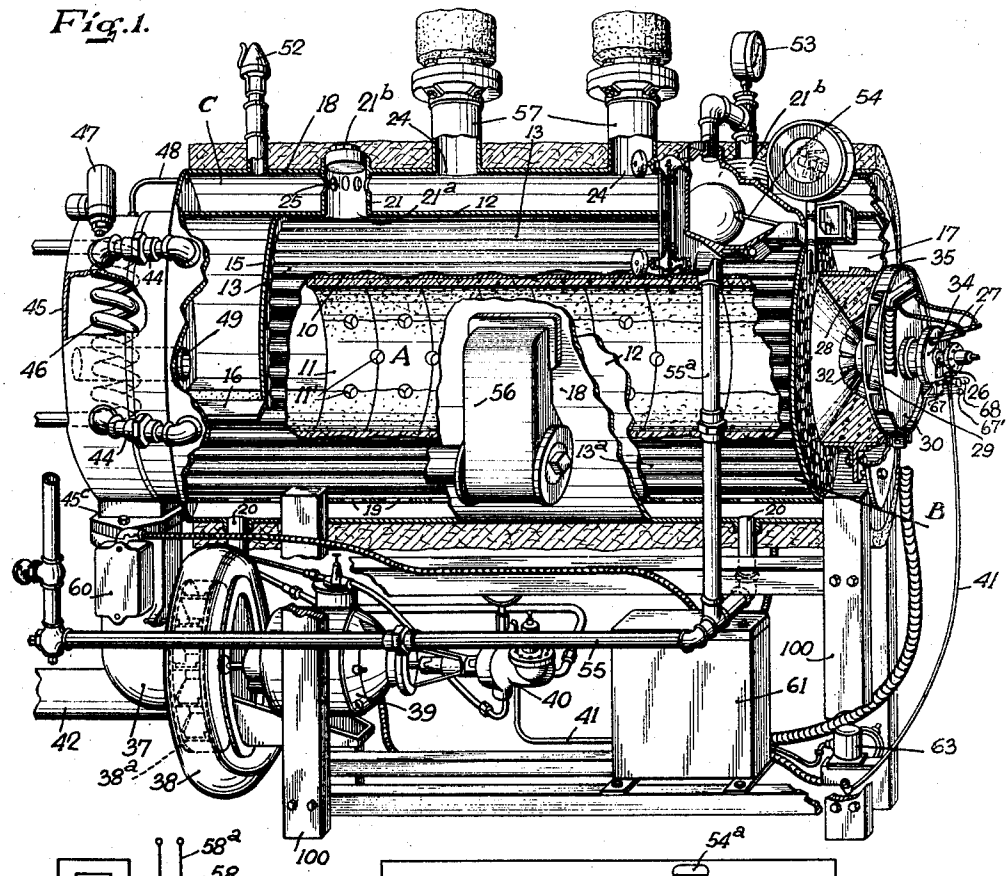
July 27, 1937. J. N. MACRAE 2,088,299

HEATING APPARATUS

Filed May 17, 1933 2 Sheets-Sheet 1

Fig. 1.



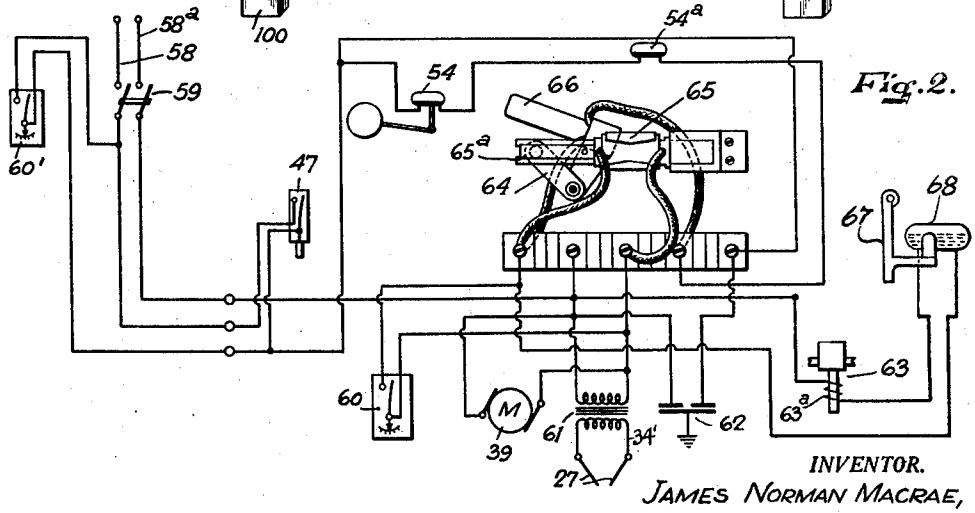


Fig. 2.

INVENTOR.
JAMES NORMAN MACRAE,
BY Dull, Dunn & Anderson.
ATTORNEYS.

July 27, 1937. J. N. MACRAE 2,088,299

HEATING APPARATUS

Filed May 17, 1933 2 Sheets-Sheet 2

Fig. 3

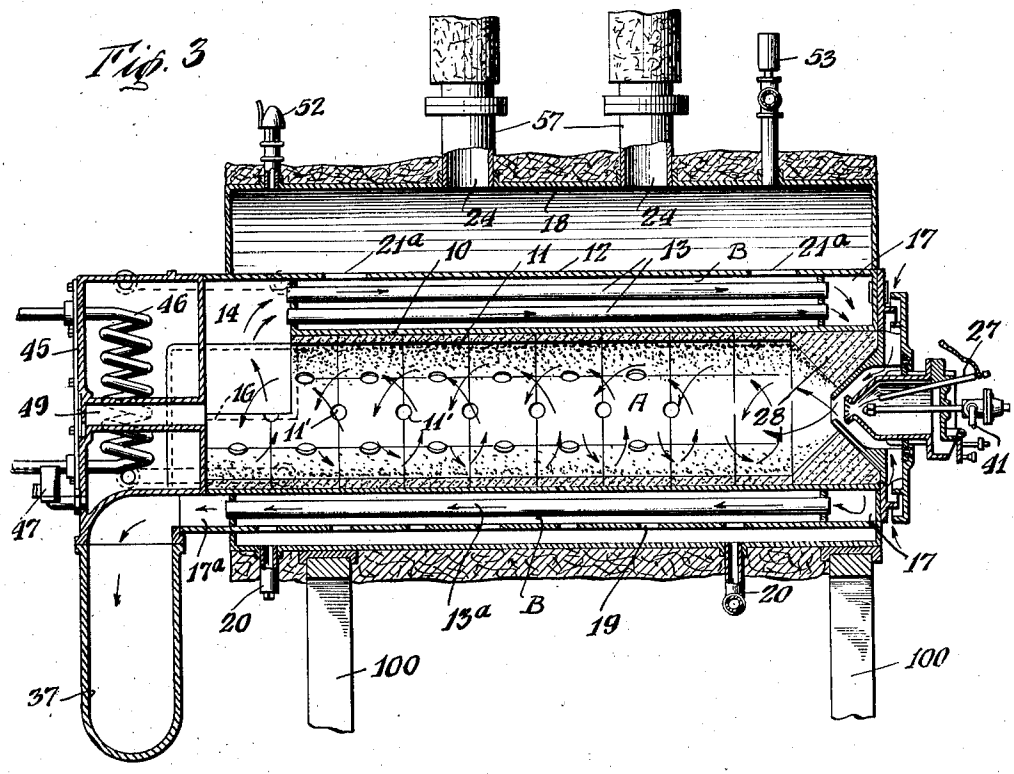


Fig. 4

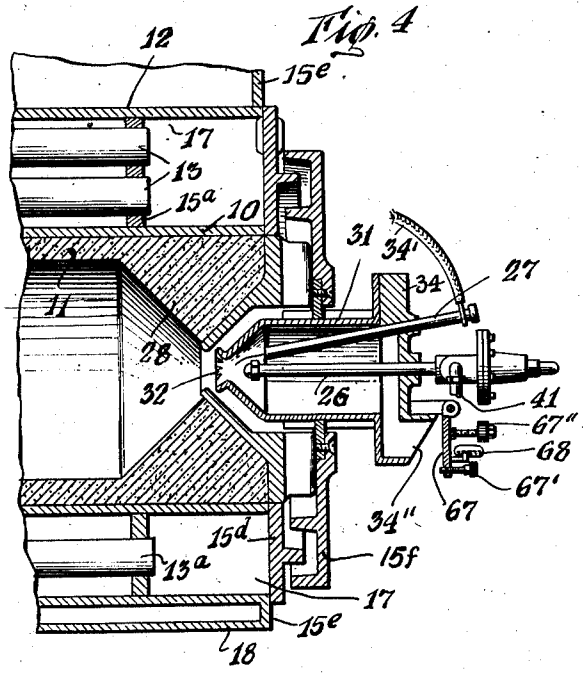
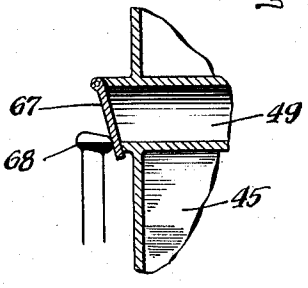


Fig. 5



INVENTOR
JAMES NORMAN MACRAE
BY
Dell & Kane
ATTORNEYS

Patented July 27, 1937

2,088,299

UNITED STATES PATENT OFFICE

2,088,299

HEATING APPARATUS

James Norman Macrae, Morristown, N. J.

Application May 17, 1933, Serial No. 671,524

10 Claims. (Cl. 158—28)

This invention relates to a heating apparatus, and in its more specific aspects aims to provide a control for such apparatus and which may be employed in association with a boiler, furnace, or other suitable heat exchange structure, utilizing oil, gas, or similar fuels as a primary source of heat.

It is an object of the invention to provide a unit of this character which will effectively control the fuel in such manner that the danger of explosions, or "pull-backs" occurring will be minimized if not entirely eliminated.

A further and in certain respects more specific object of the invention is that of providing a control by means of which no burning of fuel may occur unless the parts of the burner mechanism are functioning with proper efficiency.

Still another object is that of constructing an improved control which will prevent combustion occurring should the flue extending from the heat exchange apparatus or the parts of the latter be clogged or impeded to an extent such that the apparatus is in an unsafe condition.

An additional object is that of providing a unit of this character and which will serve to prevent the retention of any unburned products of combustion in the combustion chamber.

Still another object is that of providing a control of this type which will embody an improved construction and which may be applied to apparatus as heretofore manufactured as well as apparatus in current manufacture, and which will take into special contemplation the inclusion of such control. Moreover, according to the present invention, an apparatus is provided which will operate over long periods of time with freedom from difficulties.

With these and other objects in mind, reference is had to the attached sheets of drawings in which:

Fig. 1 is a perspective view of the heating apparatus with a portion of the parts broken away and other parts illustrated in section so as to disclose the general arrangement of the unit, such heating apparatus moreover having in association therewith one form of the improved control to which the invention is primarily dedicated;

Fig. 2 is a somewhat diagrammatic view of one form of wiring circuit which may be associated with a heating apparatus and control of this nature;

Fig. 3 is a sectional side view of the heating apparatus and control mounted thereon;

Fig. 4 is a fragmentary enlarged view of the intake head forming a part of the apparatus, and

Fig. 5 shows an alternative form of the control which may be employed.

It should be borne in mind that the heating apparatus as illustrated is merely one desirable form of unit which lends itself ideally to use in connection with a control such as forms a part of the present invention. It is to be understood that the control and modifications thereof may equally well be employed in connection with other types of heating and fuel burning apparatus.

Thus referring primarily to Figs. 1, 3, and 4, the numeral 10 indicates a shell defining a combustion chamber A which may be lined with a refractory as at 11, which refractory may be formed with recesses as at 11'. Surrounding this shell and spaced therefrom is a cylinder 12. The space B between the cylinder and shell provides the boiler proper through which tubes 13 may extend. The shell 10 may be interrupted adjacent its rear upper end as at 14 to provide a passage or flue through which flame and products of combustion may flow into the tubes 13. This space is sealed by partitions 15 and 16 so that the water will be retained in the boiler proper. The end wall of this boiler terminates at a point short of the end wall of cylinder 12. Accordingly a space 17 is provided through which the products of combustion, after flowing through tubes 13, may flow downwardly and thence rearwardly through tubes 13a extending through the lower portion of the boiler and which communicate with a rear space or flue 17a.

Surrounding the cylinder 12 and spaced therefrom is a further cylinder 18. This cylinder, as illustrated, is preferably eccentrically disposed with reference to cylinder 12. Communication between the interior of the boiler and cylinder 18 is afforded through a series of openings 19 adjacent the lower face of the latter as well as openings 21a. As shown in Fig. 1, a collar 21 may be arranged in line with openings 21a and have apertures 25 through which the heated fluid flows. Otherwise such fluid may flow directly as shown in Fig. 3 from the openings 21a to the openings 24 in cylinder 18, passing thence upwardly through risers 57. The openings 19 serve to permit of ready replenishment of water within the boiler proper, especially where a heating apparatus of this nature is utilized in connection with steam and vapor systems. It is obvious that as the water level drops, the water contained in cylinder 18 may flow through these openings. Moreover, the cylinder may be pro-

vided with fittings 20, one of which may serve as a drain and the other of which may provide a water intake through pipe 55.

Coupled to the rear of the boiler is a head 45 through which fluid heated within the boiler may flow, for example, through unions 44. This head may be provided with a sight opening or tube 49 through which the interior of the combustion chamber may be viewed. Positioned within the head are a suitable number of coils 46, it being understood that a suitable control 47 commonly known as an "aquastat" may be associated with this head or with the boiler proper for maintaining the temperature of the fluid at a suitable high level. With a view to preventing any entrapment of air, a bleeder pipe 48 may be furnished as in Fig. 1 between the upper end of head, or water back 45, and the upper end of cylinder 18.

Adjacent the rear end of return tubes 13*a*, a connection 45*c* is provided with which a stack 37 is coupled. The stack communicates with a fan casing 38 within which a fan 38*a* is positioned. This fan may be driven by a motor 39 which also serves to drive a pump 40 to feed fuel through a line 41 within which is interposed a valve 63, electromagnetically controlled as at 63*a*.

As shown, especially in Fig. 4, the inner wall of chamber 17 is defined by a partition 15*a* and the outer wall thereof by a partition 15*d*. The inner end of cylinder 18 is in this view identified at 15*e*. Wall or partition 15*d* may be flanged, as in this figure on its exterior surface, and mount a plate 15*f* in spaced relationship so that air may be drawn between surfaces 15*d* and 15*f*, through the venturi 28 which may form a part of refractory 11. In Fig. 1 a slightly different construction has been used in which the outer plate or partition 15*d* is provided with radially extending flanges 29, overlain by a plate 30. The space between these elements is capable of being closed to a greater or lesser extent by a band 35.

Regardless, however, of the precise construction of the air intake, it is preferred to associate therewith a unit 34 including an inwardly extending tube portion 31 terminating in a Venturi portion 32. A fuel nozzle 26, connected with line 41, is also supported by this unit and electrodes 27 are likewise supported and extend to a point adjacent the end of the nozzle. The space between plates or surfaces 15*f* and 15*d* or 15*d* and 30 affords passages, adequate for the flow of combustion air to a point beyond venturi 32. In order to provide for the flow of air within tube 31, the unit 34 is formed with a passage 34''. As illustrated in Figs. 1, 3, and 4, this passage may be closed by a flap valve 67 provided with an adjustable stop member 67' and mounting, for example, switch 68, as well as a counter-balancing weight 67''. It is, of course, obvious that with no air flowing through passage 34'', this control member will remain in the position illustrated. Should it be desired, this position may, of course, vary according to the needs of given installations by adjusting the weight 67''. Should, however, a sufficient volume of air be rushing through opening 34'', member 67 will be drawn toward the mouth of this passage, insofar as this is possible, consistent with the position of the bolt or stop member 67'. In so moving, it will, of course, tilt and the switch 68 will be actuated.

In the event it is desired not to provide this control adjacent the intake head, it will be appreciated that as shown in Fig. 5 it may be pivotally supported, for example, adjacent the outer end of tube 49 (in which case a second tube 49*a* will be furnished to provide a side opening) and will, of course, mount the switch 68. In this form it will again be understood that a sufficient inrush of air through tube 49 will shift member 67 to actuate switch 68.

The unit may, of course, additionally include and mount a pressure relief valve 52, a gauge 53, and a low water cut-off 54. A branch pipe 55*a* of pipe 55 may be connected to the latter to assure proper distribution of the water, and a flushing of sediment towards the lower end of cylinder 18. The entire unit may also be mounted upon a proper support 100 which may also provide a convenient mounting for a control casing 61 within which certain of the controls hereinafter described are arranged.

These controls are probably best visualized by referring to Fig. 2, in which feed lines 58 and 58*a* extend from a suitable source of electrical current supply, which source may be completely disconnected from the unit by means of a switch 59. What is commonly known as a room thermostat 60' is provided, and the aquastat 47 is connected conveniently as shown, as is also the low water cut-off 54 as well as boiler limit switch 54*a*. It will also be observed that, as shown, 60', 54, 54*a*, motor 39 and resistance heater 65 are arranged in one circuit. It will also be noted that the combustion safety switch 60 is shunted around the resistance heater 65 so that when this switch closes upon establishment of combustion, the resistance heater 65 will be shunted out of circuit and rendered ineffective. The transformer 61 which supplies energy to the electrodes 27 through, for example, leads 34', as shown in Fig. 4, is connected into the main motor circuit so that substantially immediately upon the closing of that circuit the electrodes will function. These electrodes may be of the ordinary continuously operating type (as shown) or of the intermittent type if desired. As also shown, it is desirable that a trap 62 be provided so that the unit will not cause interference with radio reception. The manner in which the windings 63*a* of the electromagnetically controlled valve 63 are included in the circuit is also clearly indicated in Fig. 2. It will finally be observed, with reference to Fig. 2, that the resistance heater 65 has associated with it a warp bar 65*a* and a safety switch 66 which is of the time control type and includes a mercury tube mounted upon a swingable arm or crank 64.

These controls and their functions are well known to those skilled in the art, and serve to cause normal initiation or interruption of operation by, for example, operation of the room thermostat or the aquastat. Interruption of operation due to abnormal conditions occurs, for example, through the existence of the stack control, the low water cut-off, or the pressure cut-off. Interruption to operation will also occur if the electromagnetically or suction controlled fuel valve fails to function properly.

Suffice it to say that if, for any reason, the circuit through motor 39 is closed, it will also be closed through the transformer supplying high tension current to the electrodes. Functioning of the motor will cause air to be drawn through the intake head 34 and the tube 31. If the inrush of air is in proper volume, a sufficient amount of air will also be drawn through opening 34'' as the motor comes up to speed. It will, of course, also be obvious that if tube 49 is open, air will rush through it. In either event

switch 68 will be shifted to open valve 63 and permit fuel under pressure to be discharged from nozzle 26. This fuel will be ignited and will mix with air passing through the passages of the intake head and combustion will occur within chamber A. The products of combustion will flow through space 14, tubes 13, downwardly through passages 17 (thus heating the air moving adjacent the surfaces of partition or plate 15d), and the products of combustion will thence flow through tubes 13a, stack 37, fan-housing 38 and so to stack 42.

As aforementioned, a proper volume of air must be flowing through opening 34'' or tube 49 if the switch is to be actuated. If insufficient air is passing through the opening with which the control is associated, then the switch will not function. In other words, if the motor is operating slowly, due to its being damaged or due to low voltage, no fuel will be fed from the nozzle. The same is true if the fan is damaged or if a sufficient number of the tubes or other passages are clogged to prevent the fan from drawing a proper volume of air. Thus, factors which might normally be conducive to an explosion occurring, will automatically prevent the initiation of combustion so that no damage may occur. If, on the other hand, the parts are operating properly, it is apparent that the fan, in arriving at a speed sufficient to open the fuel control valve, will scavenge the combustion chamber and all passages of the heating apparatus of any unburned fuel mixture before the fuel valve opens and actual combustion occurs. Conversely, it will be some time after cessation of motor energization before the fan ceases to rotate. However, substantially simultaneously with de-energization of the motor, the inrush of air will drop, so that the switch 68 or equivalent control will function to interrupt the flow of oil. Therefore it follows that the combustion chamber will be scavenged and also cool air will be drawn through the intake head and past the nozzle, electrodes, etc., to assure against their being damaged.

From the foregoing it will be appreciated that among others, the several objects of the invention as afore noted are achieved. It will also be understood that numerous changes in construction and rearrangements of the parts might be resorted to without departing from the spirit of the invention as defined by the claims.

I claim:

1. A heating apparatus including a head, a nozzle supported by said head, a fuel-flow controlling valve connected to said nozzle, means for governing said valve, said head being formed with an opening through which air may flow, a flap member hingedly secured to said head adjacent said opening, and a switch element carried by said flap member and connected to said valve-governing means to control the functioning of the valve and operated by air flowing through said opening.

2. A heating apparatus including a head, a nozzle supported by said head, a fuel-flow controlling valve connected to said nozzle, means for governing said valve, said head being formed with an opening through which air may flow, a flap member hingedly secured to said head adjacent said opening, a switch element carried by said flap member and connected to said valve governing means to control the functioning of the valve and operated by air flowing through said opening, and means for varying the range of movement of said flap with respect to said head.

3. A heating apparatus including a head, a nozzle supported by said head, a fuel-flow controlling valve connected to said nozzle, means for governing said valve, said head being formed with an opening through which air may flow, a flap member hingedly secured to said head adjacent said opening, a switch element carried by said flap member and connected to said valve governing means to control the functioning of the valve and operated by air flowing through said opening, and a counterweight secured to said flap to establish the normal position of the same with respect to said head.

4. A heating apparatus including a head, a nozzle supported by said head, a fuel-flow controlling valve connected to said nozzle, means for governing said valve, said head being formed with an opening through which air may flow, a flap member hingedly secured to said head adjacent said opening, a switch element carried by said flap member and connected to said valve governing means to control the functioning of the valve and operated by air flowing through said opening, and a stop member secured to said flap and engaging said head as the former is drawn into opening-sealing position for limiting the movement of said flap.

5. A heating apparatus including, in combination, a heat exchange structure formed with inlet and outlet openings, a fan connected to said outlet opening, a fuel nozzle disposed adjacent said inlet opening, a valve controlling the flow of fuel to said nozzle, a flap hingedly connected to said structure in advance of said fan and movable by the draft set up when the fan causes a normal volume of air to flow from said inlet opening through said heat exchange structure, and means carried by said flap and connected to said valve to control the position of the latter in accordance with the position of said flap.

6. A heating apparatus including, in combination, a heat exchange structure formed with inlet and outlet openings, a fan connected to said outlet opening, a fuel nozzle disposed adjacent said inlet opening, a valve controlling the flow of fuel to said nozzle, a flap hingedly connected to said structure in advance of said fan and movable by the draft set up when the fan causes a normal volume of air to flow from said inlet opening through said heat exchange structure, electric means governing the position of the valve and a switch connected to said flap and causing operation of said electric means in response to flap movement.

7. A heating apparatus including, in combination, a heat exchange structure formed with inlet and outlet openings, a fan connected to said outlet opening, a fuel nozzle disposed adjacent said inlet opening, a valve controlling the flow of fuel to said nozzle, a flap hingedly connected to said structure in advance of said fan and movable by the draft set up when the fan causes a normal volume of air to flow from said inlet opening through said heat exchange structure, electromagnetic means for controlling the position of said valve and a gravity actuated switch mounted on said flap and connected to said electromagnetic means whereby the position of said flap governs the position of said valve.

8. In a heating apparatus, a fuel nozzle, a valve controlling the flow of fuel to said nozzle, means supporting said nozzle and being formed

with an opening to admit air to the apparatus, a member hingedly supported adjacent said opening and movable by air flowing through the same, and means connected to said member and to said valve for governing the position of the latter in accordance with the position of said member as determined by the volume of air flowing through said opening.

9. In a heating apparatus, a member to be connected to a combustion chamber, said member being formed with an opening through which combustion air is to flow, means for causing such air flow, a fuel supply pipe, a fuel valve interposed within said pipe for controlling the flow of fuel therethrough, operating means for said valve, means movably supported adjacent the opening of said member and movable solely in response to air flowing through the same, and means connecting said last named means to said fuel valve operating means to cause a closing of said valve upon less than a predetermined amount of air flowing through said member.

10. A heating apparatus including, in combination, a heat exchange structure formed with inlet and outlet openings, a fan connected to said outlet opening to draw air through said inlet opening, the heat exchange structure and said outlet opening, a motor operating said fan, means controlled by the degree of heat within such structure and connected to said motor for discontinuing the operation of the latter when the degree of heat within such structure decreases below a predetermined point, a fuel nozzle extending into said inlet opening, a fuel supply pipe connected to said nozzle, an electromagnetically controlled valve connected to said pipe for controlling the flow of fuel to said nozzle, a switch connected to the electromagnet of said valve for controlling the opening and closing of the latter, means movably supported by said apparatus and maintained in one position in response to flow of a certain volume of air moving through said heat exchange structure, said means assuming another position when a lesser volume of air is passing through said heat exchange structure, and said switch being operatively connected to said last named means to cause a closing of said valve when such lesser volume of air is flowing through such structure.

JAMES N. MACRAE.