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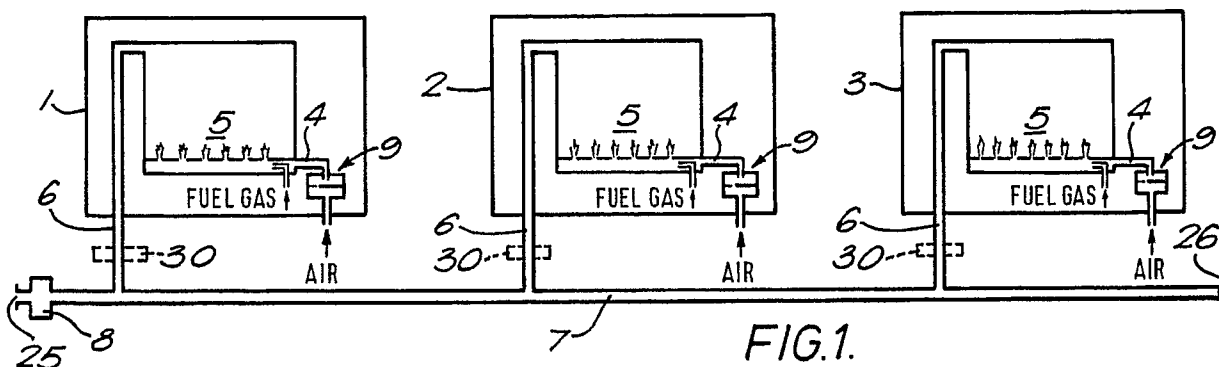
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54 **Gas fired appliances and installations incorporating such appliances.**

57 An installation comprises one or more gas-fired appliances 1,2,3. Each appliance has an inlet 4 for combustion air and an outlet 6 for products of combustion formed by the appliance. Each outlet is connected to a common flue conduit 7. Downstream of the appliances a fan 8 is connected to the flue conduit to induce combustion air into the appliances and combustion products from the appliances into

and through a flue conduit 7. Associated with each appliance, upstream of the flue conduit, a respective adjustable valve 9 controls the rate at which combustion air is induced into the appliances over the heat output range of the particular appliance. Conveniently, the adjustable valves are self-regulating so that they automatically regulate the flow of air to the appliances.



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GAS FIRED APPLIANCES AND INSTALLATIONS INCORPORATING SUCH APPLIANCES

The present invention relates to gas-fired appliances and, more particularly, to installations incorporating such appliances.

According to the invention, an installation comprises at least one gas-fired appliance having an inlet for combustion air and an outlet for products of combustion formed by the appliance, the outlet of the appliance being connected to a flue conduit, a fan connected to the flue conduit downstream of the appliance and operable to induce air into the appliance and combustion products from the appliance into and through the flue conduit, the appliance having associated therewith, upstream of the flue conduit, adjustable valve means to control the rate at which combustion air is induced into the appliance over the heat output range of the appliance.

In this specification the terms 'upstream' and 'downstream' are relative with respect to the direction of flow of combustion products through the flue conduit.

The installation may comprise a plurality of such gas-fired appliances, in which case the outlets of the appliances are connected to a common flue conduit and the adjustable valve means of each appliance controls the rate at which combustion air is induced into the respective appliance over the heat output range of that appliance.

In such an installation a single sufficiently powered fan may be provided to induce the required amounts of draught for all of the appliances over their normal minimum to maximum heat output ranges.

Moreover, the development of small high pressure fans such as toroidal fans allows the flue conduit in the installation to be a so-called 'miniature' flue conduit.

At the present time, the internal diameter of 'miniature' flues when used with domestic appliances, eg. of up to 20kw output, are of the order of 30mm or less, for example 22mm. It is envisaged that with the development of more powerful fans, 'miniature' flues may be somewhat greater than 30mm when used with commercial appliances.

One advantage of miniature flues assisted by high pressure fans over natural draught flues is that the former can operate not only with vertically disposed sections of flue but also with approximately horizontally disposed sections of flue. Furthermore, 'miniature' flues are relatively easy to install and are less obtrusive. A horizontal section or run of the flue may, for example, be routed around part of a skirting board in a room.

Control of the volume flow rate of combustion air by adjustable valve means is particularly useful

in a "miniature" flued conduit system. The volume flow rate of combustion air to each appliance is sensitive to variations in pressure drops across both the appliances and the flues connected to them. In a miniature flued conduit the pressure drops across both flues and appliances are similar and therefore changes in the effective length of flue or the number of appliances connected to the flue significantly effects the flow rates to each of the individual appliances.

The, or one or more of the, adjustable control valve means may be self-operating or self-regulating valves, such as pressure-sensitive self-regulating valves. For example, the or each such valve may comprise two interconnected chambers separated by partition means comprising a fixed wall part which includes an opening providing communication between the chambers and a movable wall or diaphragm, each chamber wall having an opening therein, the opening of one of the chambers being connected to a tubular member which extends towards and terminates close to the adjacent side of the diaphragm to provide a gas flow control opening between the end of the tubular member and the diaphragm, which control opening is variable in size dependent on the position attained by the diaphragm in response to pressure difference between the gases in the two chambers. Conveniently, where there is a plurality of appliances, all of the control valves may be self-regulating valves.

From another aspect, the invention provides a pressure-sensitive self-regulating control valve as defined above.

From a further aspect, the invention provides a gas-fired appliance incorporating a pressure-sensitive self-regulating control valve as defined above.

The movable wall or diaphragm may be resiliently biased towards an optimum position in order to facilitate control of the relative positions of the movable wall or diaphragm and the end of the tubular member. For example, resilient means, such as a spring, may be provided so as to act between the movable wall or diaphragm and a chamber wall. Alternatively, the diaphragm may itself be made of a resilient material, such as a rubber material, which is capable of resiliently flexing about an optimum position.

Alternatively, the or one or more of the control valve means may be manually adjustable control valves such as gate valves. In this case, where there is a plurality of appliances and two or more appliances each have a respective manually adjustable control valve, the manual valve for each appliance is adjusted to provide the required rate of the flow of air or flue gases. In order to balance an

installation having manual control valves one procedure involves measuring volume flow rates through each appliance, for example, from calculations determined from the compositions of the combustion products from each appliance. However, as each valve is adjusted it effects the performance of all the other appliances in the system and a long repetitive process may be required to achieve an acceptable performance from each of the appliances, that is to balance the system.

Should appliances be added to or removed from such a balanced installation the installation would become unbalanced and all the appliances would have to be balanced or re-balanced.

Preferably, the or each control valve means is located upstream of the combustion zone of the or the respective appliance and is connected to the combustion air inlet of the, or the associated, appliance.

Alternatively, the or each gas control valve means may be located downstream of the combustion zone of the or the respective appliance and connected to the outlet for the combustion products of the, or the associated, appliance. However, in this case the valve means would have to be sufficiently robust to withstand the more adverse conditions, for example, higher temperatures, more corrosive gases and possibly condensates.

The, or one or more of the, appliances may be high-efficiency gas-fired appliances, ie. appliances having an efficiency of about 88% or more or where the flue gas inlet temperature is about 60 °C or less.

In order that the invention may be more readily understood reference will now be made, by way of example only, to the accompanying drawings, in which:-

Figure 1 shows in schematic form one embodiment of the installation according to the invention,

Figure 2 is an enlarged view of one of the self-regulating control valves used in the installation shown in Figure 1, and

Figure 3 shows a modified valve to that shown in Figure 2.

In Figure 1 an installation comprises, for example, three gas-fired appliances such as a water heater or multi-point heater 1, a convector 2 and a fuel effect fire 3. Each appliance has an inlet 4 for combustion air, and an outlet pipe 6 for products of combustion formed by burning fuel gas, supplied from a gas supply in the combustion zone 5.

The outlet pipes 6 of the appliances are connected to a common flue conduit 7. Downstream of the connections of the pipes to the conduit, an electrically powered fan 8, such as a toroidal fan, is connected to the conduit 7 and is operable to induce combustion products through the outlet

pipes 6 from the appliances and into and through the conduit 7 and to induce combustion air through the air inlets 4 into the appliances, as a result of the induced draught through the conduit.

A pressure-sensitive self-regulating control valve 9 is connected to the air inlet 4 of each appliance. The gas control valves control the rate at which combustion air is induced into the respective appliances over the normal heat output range of those appliances.

The construction of each gas control valve 9 may be seen more clearly in Figure 2. The valve comprises an enclosure 10 which is internally divided by partition means into two chambers 11, 12. The partition means on the one hand comprises a fixed wall part 13 which is provided with an opening 14 which allows communication between the chambers and, on the other hand, a flexible diaphragm 15 located in, and so as to close an opening in the fixed wall part 13.

The wall 16 of the chamber 11 is provided with an inlet opening 17 via which combustion air enters the gas control valve.

The wall 18 of chamber 12 has extending therethrough a tubular member 19 providing an outlet 20 from the chamber. The tubular member 19 extends in opposite directions from the chamber wall so as to provide a first tubular part 21 which is outside the chamber and connected to the air inlet 4 of the appliance which leads to the combustion zone, and a second tubular part 22 which extends inwardly from the chamber wall and terminates close to the adjacent side of the diaphragm 15. A gas flow control opening 23 is defined between the end 24 of the tubular part and the diaphragm 15. The opening is variable in size dependent on the position of the diaphragm 15 with respect to the end 24 of the tubular part 22. Such position of the diaphragm depends on the pressure difference between the chambers 11, 12 on the opposite sides of the diaphragm. A change in air flow rate causes a change in pressure difference which causes movement of the diaphragm 15 towards or away from the end 24 of the tubular part 22 to cause the opening 23 to be reduced or increased in size with the result that the rate of flow of combustion air induced through the control valve is returned to its original value.

A flue terminal 25 is provided at the end of the conduit downstream of the fan whilst the other end of the conduit is closed off as at 26. The conduit may be installed in a carcass or duct which may, conveniently, be a skirting duct which may also house the gas and/or power supply lines. The flue conduit 7 and the outlet pipes 6 are of continuous or closed form along their lengths, that is 'room-sealed' along their longitudinal walls between the combustion zones and the flue terminal 25.

In the installation each appliance is so balanced with respect to the remainder of the system that it can be supplied with combustion air at a suitable flow rate over the normal expected heat output range of the appliance. Thus, the fan is sufficiently powerful to meet the maximum required flow rates, (ie. with each appliance providing maximum heat output) and the pressure drops within the complete system, that is through all the flue conduit or pipework and all the appliances.

As mentioned above, the supply of combustion air to the appliances is regulated by the self-regulating or automatic control valves. Each appliance may be supplied with the associated valve already fitted thereto, for example, by the manufacturer of the appliance. Each control valve automatically regulates the flow of air to the appliance to a predetermined volume flow rate set, for example, by the appliance manufacturer. The control valve compensates for any length of flue conduit and for the addition or removal of appliances to or from the installation, subject to certain upper limits. Air is drawn through each appliance when the fan 8 is operating even if the appliance is not 'on', that is not functioning by burning fuel.

The principle of the operation of the control valve is, broadly, somewhat similar to the operation of known kinds of gas volume control governors. In the present installation the valves have to respond to low pressure differentials, in the order of a few millibar, and provide a variable restriction or sized opening 23 resulting from the pressure differential set up across the opening 14. For example, a reduction in volume flow rate in the outlet 20 of the valve (which may be caused as a result of another appliance being turned on and thus an increase in pressure in the flue conduit because of more flue gases) reduces the volume flow rate of air through the control opening 14 which in turn reduces the pressure differential across the control opening and thus between the chambers on opposite sides of the diaphragm and thereby causes the diaphragm, under its own weight, to move away from the tubular member 19. This increases the size of the opening 23 between the end 24 of the tubular member 19 and the diaphragm 15 and results in an increase in the air flow rate through the outlet 20 so as to bring the air flow rate back towards a preset optimum.

If the flow rate increases in the outlet 20 then the diaphragm 15 moves towards the end 24 of the tubular member and thereby reduces the air flow rate through the outlet 20 in an attempt to bring it back towards the desired optimum.

These pre-set control valves 9 may constantly regulate themselves so as to re-adjust the air flow rates into the appliances back toward the optimums for those appliances.

By employing an installation as described above, a modular heating and hot water system may be provided for a gas consumer. It will be appreciated that such an installation may be expanded by adding further appliances. The induced draught generated in the flue conduit 7 means that the flue is operating under negative pressure conditions, ie. at pressures less than ambient, and so is inherently safer than forced draught flues from which latter gases may be expelled through any leaks which arise into the surrounding, for example, into a room in a house. Moreover, the induced draught provides controlled ventilation through each appliance all the time since the control valves allow air therethrough and into and through the appliances irrespective of whether or not the appliances are in the 'firing' mode. This assists in reducing condensation and in making the immediate surrounding conditions more comfortable.

A central control may be provided for the individual appliances in order to control, for example 'on' and 'off' times of the appliances and the temperatures of different rooms heated by appliances incorporated in the installation.

It will also be appreciated that the installation may be employed in newly built or existing flats or houses, and that where 'miniature' flue conduits are used miniature flue terminals only require relatively small holes in outside walls of the buildings in which the installation has been provided. The single fan may be inside the room or building adjacent a wall near the flue terminal.

Use of high efficiency appliances results in relatively low temperatures in the flue conduit and means that relatively low cost plastics flue pipes may be employed to form the conduit.

In a modification of the installation shown in Figure 1, the valves 9, instead of being located to the air inlets 4, may be located in the outlets 5 of the appliances such that combustion product gases enter the valves via inlet 17 and leave via outlet 20. The positions of the valves in this modification are shown generally in dotted outline as at 30.

Moreover, the relative positions of the diaphragm 15 and the end 24 of the tubular member may, in part, be controlled by a spring 31, as shown in Figure 3, which acts between and is attached to the chamber wall 18 and the diaphragm. The construction of the valve in Figure 3 is otherwise the same as in Figure 2 and thus the same reference numerals have been used and will therefore not be described further. In such a modified arrangement the control valve may readily be disposed or oriented in a position different from the upright position shown in Figure 1. For example, the control valve may be mounted on its side or horizontally, or even upside down.

Furthermore, the air inlets to the control valves,

i.e. inlets 17 in the installation described above, may be connected to a common air supply conduit. In such an installation the appliances may be room sealed appliances which draw in combustion air from outside the building or dwelling housing the room or rooms containing the installation. The common air supply conduit and common flue conduit may be installed in a common carcass or skirting duct over substantial parts of their lengths.

Claims

1. An installation comprising at least one gas-fired appliance having an inlet for combustion air and an outlet for products of combustion formed by the appliance, the outlet of the appliance being connected to a flue conduit, a fan connected to the flue conduit downstream of the appliances and operable to induce combustion air into the appliance and combustion products from the appliance into and through the flue conduit, each appliance having associated therewith, upstream of the flue conduit, adjustable valve means to control the rate at which combustion air is induced into the appliance over the heat output range of the appliance.

2. An installation as claimed in claim 1, comprising a plurality of said gas-fired appliances and wherein the outlets of the appliances are connected to a common flue conduit and the valve means of each appliance controls the rate at which combustion air is induced into the respective appliance over the heat output range of that appliance.

3. An installation as claimed in claim 1 or claim 2, wherein the or at least one of the control valves is a pressure-sensitive self-regulating valve.

4. An installation as claimed in claim 3, wherein the or each pressure-sensitive self-regulating control valve comprises two interconnected chambers separated by partition means comprising a fixed wall part which includes an opening providing communication between the chambers and a movable wall or diaphragm, each chamber wall having an opening therein, the opening of one of the chambers being connected to a tubular member which extends towards and terminates close to the adjacent side of the diaphragm to provide a gas flow control opening between the end of the tube and the diaphragm, which opening is variable in size dependent on the position attained by the diaphragm in response to pressure difference between the gases in the two chambers.

5. An installation as claimed in any of claims 1 to 4, wherein the or each control valve is located upstream of the combustion zone of the or the respective appliance and is connected to the or the associated combustion air inlet.

6. An installation as claimed in any of claims 1

to 4, wherein the or each control valve is located downstream of the combustion zone of the or the respective appliance and is connected to the or the associated outlet for products of combustion.

7. An installation substantially as hereinbefore described with reference to the accompanying drawings.

8. A control valve as defined in claim 4.

9. A gas-fired appliance incorporating a control valve as claimed in claim 8.

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