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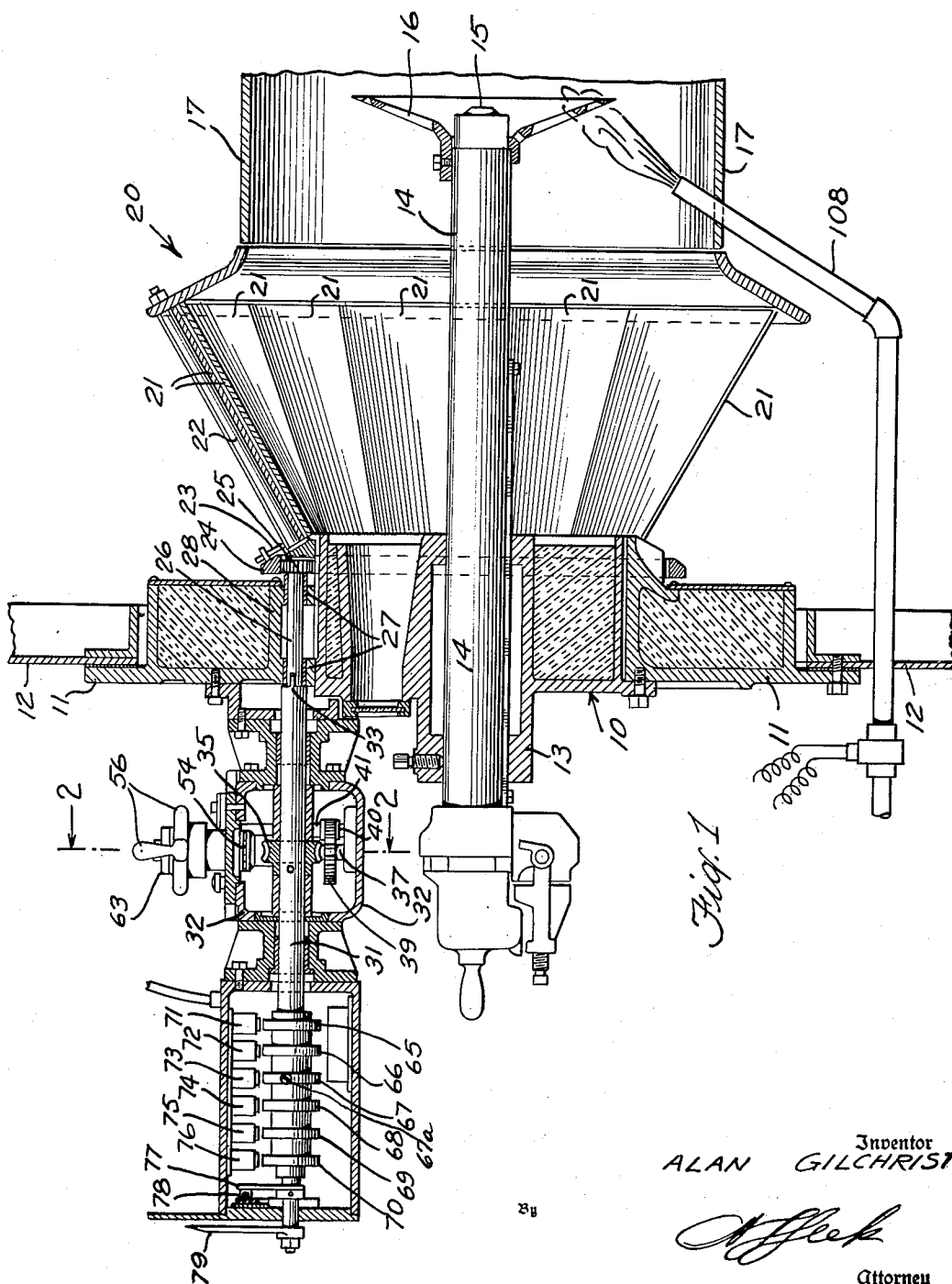
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BURNER AIR REGISTER AND FUEL CONTROL SYSTEM

Filed July 20, 1953

2 Sheets-Sheet 1



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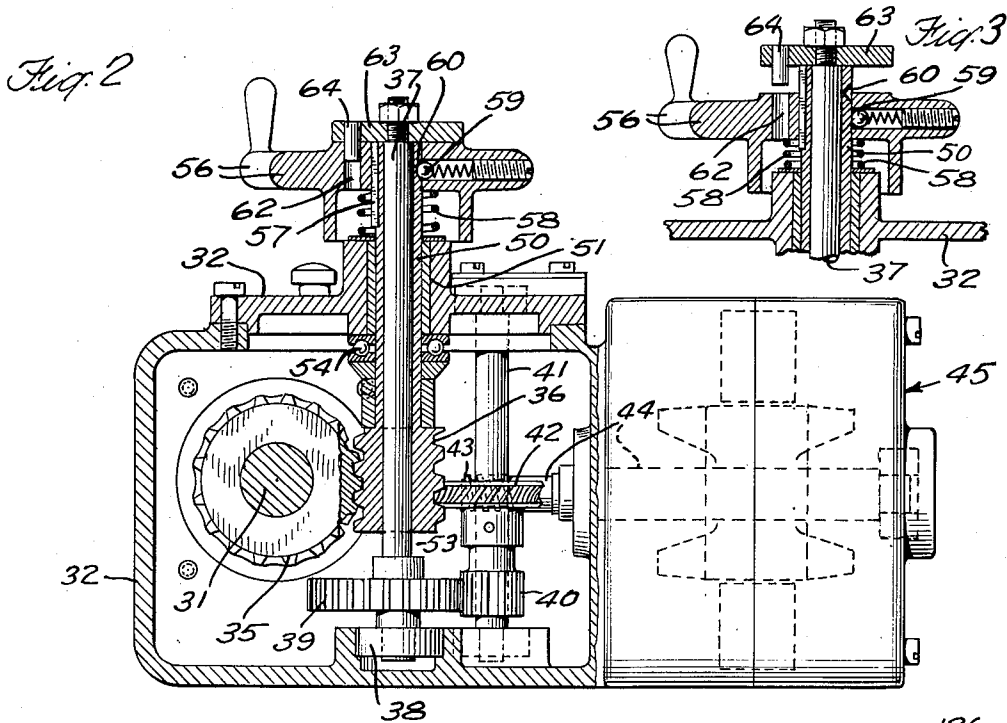
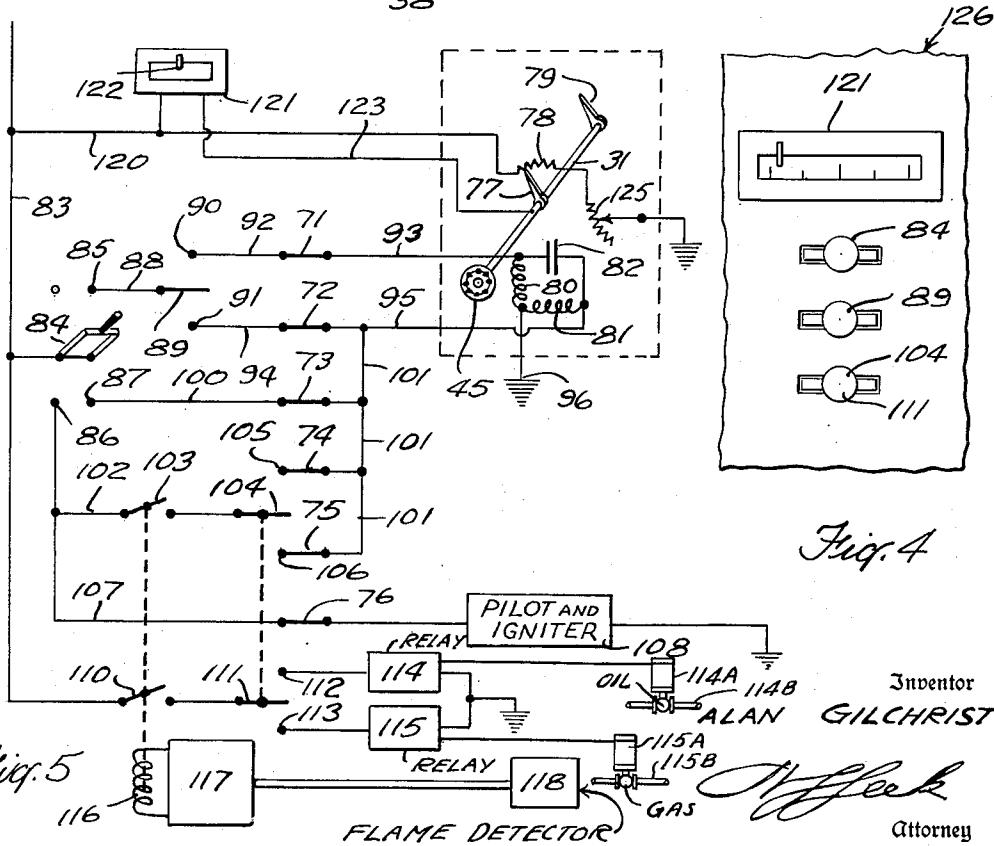
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1

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BURNER AIR REGISTER AND FUEL CONTROL SYSTEM

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8 Claims. (Cl. 158—11)

This invention relates to air registers for fuel burners and more particularly to remote control apparatus for controlling the position of the air register doors.

An object of the invention is to provide a remote control apparatus of the type above indicated having novel and improved operating characteristics.

Another object is to provide an apparatus of the above type in which a follow-up device is located at the control point for indicating the position of the air register doors.

Another object is to provide an air register control which is adapted to be operated as a part of an automatic burner control system.

Another object is to provide a register control system which is adapted to automatic operation.

Another object is to provide a system of the above type having a remote control which may be operated either manually or automatically.

Another object is to provide such a system which is automatically adjusted in accordance with the type of fuel being used.

Various other objects and advantages will be apparent as the nature of the invention is more fully disclosed.

The novel features which are characteristic of this invention will be better understood by referring to the following description, taken in connection with the accompanying drawings forming a part thereof in which a specific embodiment has been shown for purposes of illustration.

In the drawings:

Fig. 1 is a longitudinal section through a burner embodying the present invention;

Fig. 2 is a transverse section taken on the line 2—2 of Fig. 1 showing the arrangement of the gearing for driving the air register doors;

Fig. 3 is a detail view of a portion of the gearing showing the hand control in manual operating position;

Fig. 4 is a front elevation of a portion of a remote control panel; and

Fig. 5 is a schematic diagram showing the electrical circuit for operating the system.

The invention is shown in the drawings as applied to a burner of the general type disclosed in the Vroom Patent No. 2,446,069, dated July 27, 1948, which comprises a register front plate 10 attached by a flange 11 to the front wall 12 of the plenum chamber. The front plate 10 has a hub 13 in which an atomizer barrel 14 is mounted for axial movement. The atomizer barrel 14 carries an atomizer tip 15 and a diffuser 16 of the usual construction which are disposed within a burner tube 17 communicating with the burner throat (not shown). The burner may be adapted for any type of fuel, liquid, solid or gaseous. A standard oil atomizer has been shown for illustration only.

The front plate 10 carries an air register 20 having a plurality of peripheral air doors 21 through which air is supplied from the plenum chamber to the burner throat. The air doors 21 are shown as arranged conically

2

and mounted to pivot about individual rods 22. For adjusting the air doors each of the doors is provided with an upstanding pin 23 fastened to an annular member 24 having internal gear teeth which by rotation causes pivotal movement of all of the air doors in unison. The internal teeth of the annular member 24 are shown as engaged by a pinion 25 mounted on a shaft 26 which is journaled in bearings 27 in a housing 28 forming a part of the front plate 10.

In accordance with the present invention a drive shaft 31, mounted in a housing 32 which is attached to the front plate 10, is coupled by a separate coupling 33 to the shaft 26. The housing 32 contains driving gears including a reducing worm gear 35 attached to the shaft 31 meshing with a worm 36 journaled on a vertical shaft 37 (Fig. 2) having at its lower end a thrust bearing 38 and a spur gear 39 meshing with a pinion 40 carried by a second vertical shaft 41. The shaft 41 carries a worm gear 42 meshing with a worm 43 carried on a shaft 44 of a reversible motor 45.

The worm 36 is attached to a sleeve 50 which is journaled in bearing 51 in the housing 32. The worm 36 and shaft 37 are prevented from axial movement by an upper thrust bearing 54 disposed about the sleeve 50 and by the bottom thrust bearing 38. A hand wheel 56 is keyed to the sleeve 50 by key 57 and is normally held in raised position by spring 58. Spring-pressed retaining ball 59 engages recess 60 in the sleeve 50 to hold the hand wheel 56 in its raised position as shown in Fig. 2. A disk 63 is attached to the end of the shaft 37 and carries a pin 64 which is adapted to engage a recess 62 in the hand wheel 56 when the latter is in its raised position as shown in Fig. 2 and to be disengaged from said recess when the hand wheel is in its lower position as shown in Fig. 3. The pin 64 and recess 62 thus constitute a releasable coupling between the shaft 37 and the sleeve 50. When the hand wheel 56 is in its raised position the sleeve 50 and shaft 37 rotate as a unit. When however the hand wheel is depressed the sleeve 50 is released from the shaft 37 so that the worm 36 may be actuated manually by the hand wheel 56 to drive the worm gear 35 and thus turn the shaft 31.

Referring to Fig. 1 the shaft 31 is shown as carrying a set of cams 65 to 70 set to actuate switches 71 to 76 respectively, a contact arm 77 forming a part of a rheostat 78, and a pointer 79. Cam 67 is adjustably secured to shaft 31 by set screw 67a and the other cams may be similarly secured if desired.

Referring to Fig. 5 the motor 45 is indicated as of the shaded pole, capacitor, reversing type having a pair of field coils 80 and 81 and a condenser 82.

The motor 45 is actuated from an A. C. line 83 through a double pole switch 84 having a contact 85 to be closed for manual operation of the motor and contacts 86 and 87 to be connected to line 83 for automatic operation. The contact 85 is connected by a lead 88 to a manual reversing switch 89 having a contact 90 to be closed for operating the motor in the direction to close the air doors and a contact 91 to be closed for operating the motor in a direction for opening the air doors. The contact 90 is connected by a lead 92 to cam-operated switch 71; thence by lead 93 to one end of the field coil 80. The contact 91 is connected by a lead 94 to cam-operated switch 72; thence by a lead 95 to one side of the field coil 81; the condenser 82 is connected across the field coils 80 and 81; and the common lead to the field coils 80 and 81 is shown as grounded at 96.

The contact 87 is connected by a lead 100 to cam-operated switch 73; thence by lead 101 to the motor lead 95. The contact 86 is connected by a lead 102 through relay switch 103 to double throw fuel selector switch 104 having contacts 105 and 106 connected respectively through

cam-operated switches 74 and 75 to the lead 101. The contact 86 is also connected by lead 107 through cam-operated switch 76 to a pilot and igniter 108 which is disposed in the burner in a position to ignite the burner in a manner well known in the art. The pilot and igniter may be of the type disclosed in the Sloan Patent No. 2,591,626, dated April 1, 1952.

The lead 83 is connected through relay switch 110 which is ganged to operate with switch 103 to double throw fuel selector switch 111 which is ganged to operate with switch 104 and is provided with contacts 112 and 113 connected respectively to relays 114 and 115 which are connected to solenoid controlled valves 114A and 115A respectively which control the flow of fuel oil and fuel gas through pipes 114B and 115B respectively. Said relays are energized to open said fuel supply valve. The switches 103 and 110 are actuated by a relay having a coil 116 which is energized by a flame detector 117 of standard construction having an element 118 which is disposed in a position to detect the presence of a flame in the burner and to energize the coil 116 when such a flame is present.

The lead 83 is also connected by a lead 120 to a rheostat 78, which in turn is connected to an adjusting rheostat 125. Voltmeter 121 having an indicating pointer 122 is connected to the lead 120 and by a lead 123 to the contact arm 77.

Operation

It is assumed that the double pole switch 84, the reversing switch 89, the fuel selector switches 104 and 111, and the voltmeter 121 are located on a panel 126 (Fig. 4) which may be remote from the burner. When it is desired to adjust the position of the register doors manually, the switch 84 is actuated to close the contact 85 and the reversing switch 89 is shifted to close either the contact 90 or the contact 91, depending upon whether the doors are to be opened or closed. The switch 89 is held in its selected operating position until the doors have reached the desired percentage of opening as indicated by the position of the pointer 122 of the voltmeter 121. It will be noted that since the voltmeter 121 is connected across the rheostat 78, the change in voltage due to the movement of the contact arm 77, which is driven with the shaft 31, will constitute an indication of the movement of the air doors. The voltmeter may be adjusted by means of the adjusting rheostat 125 so that the maximum movement of the pointer 122 corresponds to the movement of the doors from full closed to full open positions and the voltmeter may be graduated to read in percentage opening.

Cams 65 and 66 are so set that the switches 71 and 72 are respectively opened when the shaft 31 reaches the position corresponding to the limit of movement of the air doors. Hence switches 71 and 72 constitute limit switches to open the energizing circuit to the motor 45 automatically when the doors have reached the limit of their movement to open and close positions respectively.

For automatic operation the switch 84 is shifted to engage the contacts 86 and 87. This may be assumed to take place for starting purposes when the air register doors are closed and the burner is shut down. When the contact 87 is closed the motor is energized through the lead 100 and cam-actuated switch 73 to drive the shaft 31 in a direction to open the air register doors. The cam 67 is so set that the switch 73 is opened when the doors have reached ignition position which is a slightly open position.

At the same time the closing of the contact 86 energizes the pilot and igniter 108 through the lead 107 and through the cam-actuated switch 76. The burner is now set for igniting the pilot 108.

The fuel selector switches 104 and 111 are set to close contacts 105 and 112 respectively if oil fuel is to be used, and to close the contacts 106 and 113 respectively if gas is to be used for fuel.

Closing the contact 112 sets up the circuit for the actuation of the relay 114 which is connected to open the main fuel valve in the oil line (not shown) and the relay

115 is adapted to open the main fuel valve in the gas supply line (not shown).

When ignition has occurred the flame detector element 118 is energized to energize coil 116 and close contacts 103 and 110. The closing of the contact 110 energizes the relay 114 or the relay 115, depending upon the setting of the fuel selector switch 111 so as to open the main fuel valve. At the same time the closing of the switch 103 supplies power to the lead 101 for energizing the motor to drive the shaft 31 in a direction to open the air doors further.

Under the assumed conditions cams 68 and 69 are set to open the switches 74 and 75 respectively when the air doors have reached a position corresponding to the correct opening for an oil flame and a gas flame respectively. Since the switch 104 is ganged with the switch 111, switch 74 becomes effective when the relay 114 is energized for gas firing. Hence at this stage of the operation fuel for combustion is supplied to the burner and the doors are automatically opened to the correct operating position. The cam 70 is set to open the switch 76 before the air doors reach full operating position so that the igniter is then cut off.

With the burner operating under the above conditions, the switch 84 may be turned to close the contact 85 to permit manual adjustment of the doors as required by means of the reversing switch 89.

Should the flame be extinguished the flame detector will be deenergized, thereby deenergizing the coil 116 and opening the switch to the fuel valve relay to shut off fuel to the burner. The doors may then be closed.

Because of the double reduction provided by the two worm gears in the gear train, an extremely small motor may be employed for operating the doors even in large size registers.

Should it be necessary to actuate the doors manually at the register the handle 56 is depressed as shown in Fig. 3 to declutch the same from gears 39 and 40 and the worm gears 42 and 43 and to permit the shaft 31 to be turned manually through the worm 36 and worm gear 35. The door position is indicated by the pointer 79 and by the meter 121.

It is to be understood of course that the air register control may be applied to other kinds of air registers and is not restricted to the specific type of air register shown herein. Also the system is capable of various uses as will be readily apparent to a person skilled in the art.

What is claimed is:

1. In a fuel burner, an air register having a set of adjustable air doors to control the flow of air for combustion, adjusting means connected to adjust the position of said set of doors, energizable drive means connected to actuate said adjusting means, control means connected to energize said drive means for opening said doors, an igniter, said control means including limit means connected to deenergize said drive means at a door position suited for supplying air to said igniter and a second limit means connected to deenergize said drive means at a door position suited for burner operation, means rendering said first limit means and said igniter operative for ignition, a flame detector responsive to operation of said igniter, and means responsive to said flame detector to render said first limit means ineffective and said second limit means effective for positioning said doors for burner operation.

2. In a fuel burner, an air register having a set of adjustable air doors to control the flow of air for combustion, adjusting means connected to adjust the position of said set of doors, energizable drive means connected to actuate said adjusting means, control means connected to energize said drive means for opening said doors, an igniter, said control means including limit means connected to deenergize said drive means at a door position suited for supplying air to said igniter and a second limit means connected to deenergize said drive means at a

5

door position suited for burner operation, fuel supply means for said burner including a fuel supply valve, means rendering said first limit means and said igniter operative for ignition, a flame detector responsive to operation of said igniter, and means responsive to said flame detector when flame is detected to open said supply valve and render said first limit means ineffective and said second limit means effective for positioning said doors for burner operation.

3. In a fuel burner, an air register having a set of adjustable air doors to control the flow of air for combustion, adjusting means connected to adjust the position of said set of doors, energizable drive means connected to actuate said adjusting means, control means connected to energize said drive means for actuating said doors, an igniter, said control means including limit means connected to stop said drive means at a door position suited for supplying air to said igniter and a second limit means connected to stop said drive means at a door position suited for burner operation, fuel supply means for said burner including a fuel supply valve, means rendering said first limit means and said igniter operative for ignition, a flame detector responsive to operation of said igniter, means responsive to said flame detector when flame is detected to open said fuel supply valve and render said first limit means ineffective and said second limit means effective for positioning said doors for burner operation and responsive to burner flame failure to close said fuel supply valve.

4. In a fuel burner, an air register having a set of adjustable air doors to control the flow of air for combustion, adjusting means connected to adjust the position of said set of doors, reversible drive means connected to actuate said adjusting means, control means to control the operation of said drive means for adjusting said doors, said control means including a plurality of stop means operable to stop said drive means at different selected door positions, stop selecting means settable in accordance with different combustion air requirements selectively rendering said stop means operative to limit the opening of said doors in accordance with the different quantities of air required for combustion, means including a plurality of fuel valves each controlling the supply of a type of fuel for combustion to said burner, individual relay means to open said valves, fuel selector means to select one of said relay means according to the type of fuel to be burned, and means actuating said stop selecting means and said fuel selector means in unison whereby the door opening is made to correspond to the fuel requirements.

5. In a fuel burner, an air register having a set of adjustable air doors to control the flow of air for combustion, adjusting means connected to adjust the position of said set of doors, reversible drive means connected to actuate said adjusting means, control means to control the operation of said drive means for adjusting said doors, said control means including a plurality of stop means operable to stop said drive means at different selected door positions, stop selecting means settable in accordance with different combustion air requirements selectively rendering said stop means operative to limit the opening of said doors in accordance with the different quantities of air required for combustion, a pilot burner, one of said stop means being set for limiting the initial open position of said doors to provide sufficient air supply for ignition of said pilot burner and another of said stop

6

means being set for limiting the open position of said door to provide sufficient air supply for normal burner operation under load conditions, a flame detector responsive to ignition of said pilot burner, means initially rendering said first stop means effective for automatically limiting the opening of said doors to ignition position, and means responsive to energization of said flame detector adapted to render said first stop means ineffective and to render said second stop member effective for automatically limiting the opening of said doors to normal burner operating position.

6. In a fuel burner as set forth in claim 5, an igniter for said pilot burner and an energizing circuit therefor including means responsive to door position to deenergize said igniter when said doors reach a position between ignition position and full load position.

7. In a fuel burner, an air register having a set of adjustable air doors to control the flow of air for combustion, adjusting means connected to adjust the position of said set of doors, reversible drive means connected to actuate said adjusting means, control means to control the operation of said drive means for adjusting said doors, said control means including a plurality of stop means operable to stop said drive means at different selected door positions, stop selecting means settable in accordance with different combustion air requirements selectively rendering said stop means operative to position said doors in accordance with the different quantities of air required for combustion, said adjusting means comprising a shaft actuating said doors, a gear train, a clutch connecting said gear train to said shaft, a manual adjusting means to actuate said shaft, and quick acting manual declutching means adapted to actuate said clutch to disconnect said gear train from said shaft during such manual adjustment and to restore said clutch connection for resuming automatic operation.

8. In a fuel burner, an air register having a set of adjustable air doors to control the flow of air for combustion, adjusting means connected to adjust the position of said set of doors, energizable drive means connected to actuate said adjusting means, control means connected to energize said drive means for actuating said doors, a pilot for igniting said burner, fuel supply means for said burner including a fuel supply valve, means rendering said pilot operative and actuating said control means to bring said doors to a predetermined partly open position suited to supply air for operation of said pilot, a flame detector responsive to operation of said pilot, means responsive to said flame detector when flame is detected to open said fuel supply valve and to actuate said control means to bring said doors to a predetermined further open position suited to supply air for burner operation and means responsive to burner flame failure to close said fuel supply valve.

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