United States Patent

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[54] **GAS FURNACE**
15 Claims, 7 Drawing Figs.

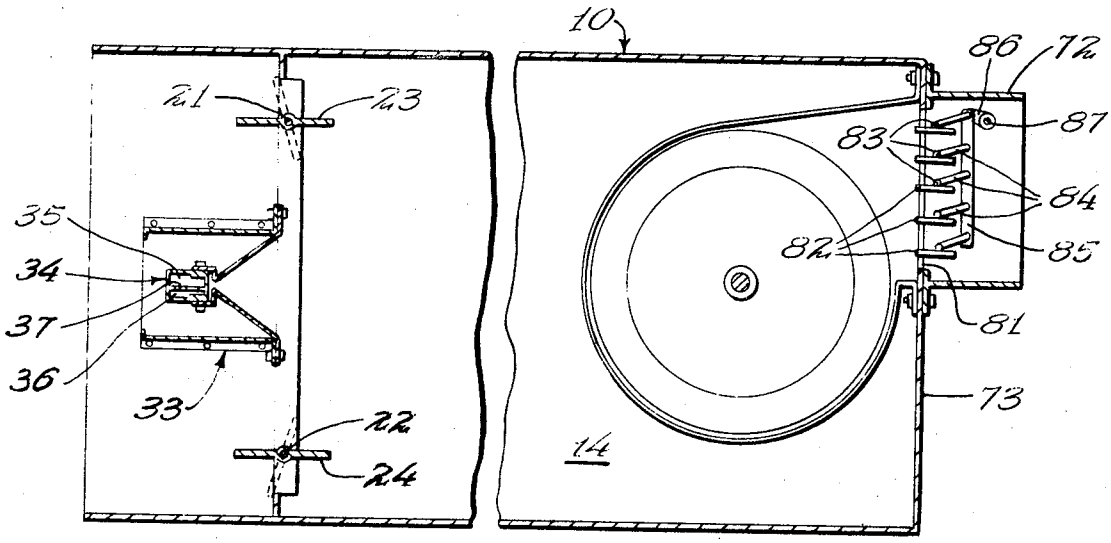
[52] **U.S. Cl.** ..... 263/19A, 126/110 C, 431/19
[51] **Int. Cl.** F23l 9/04, F24h 3/04
[50] **Field of Search** ..... 126/110 C; 263/19 A; 431/19

[56] **References Cited**
UNITED STATES PATENTS

3,294,146	12/1966	Voorheis	431/19
2,985,438	5/1961	Prowler	263/19 A
3,199,848	8/1965	Harrison	126/110 CX
3,210,059	10/1965	Nesbitt et al	263/19 A
3,417,977	12/1968	Nelson	263/19 A

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ABSTRACT: A gas furnace capable of maintaining a constant pressure differential across a burner unit irrespective of changes in the flow of air through the furnace by the use of a controlled bypass damper adjacent the burner unit. Additional features includes controlling the volume of air at the discharge end of the furnace, thus, affording improved fan efficiency, a capability to circulate air through the furnace without heating when no heat is required, and a circuit designed to protect the furnace from air circulation when the incoming air is below a predetermined temperature.



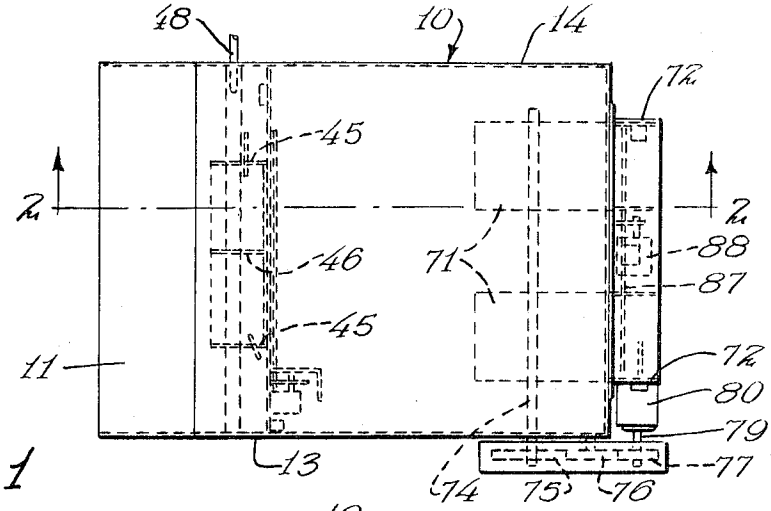


FIG. 1

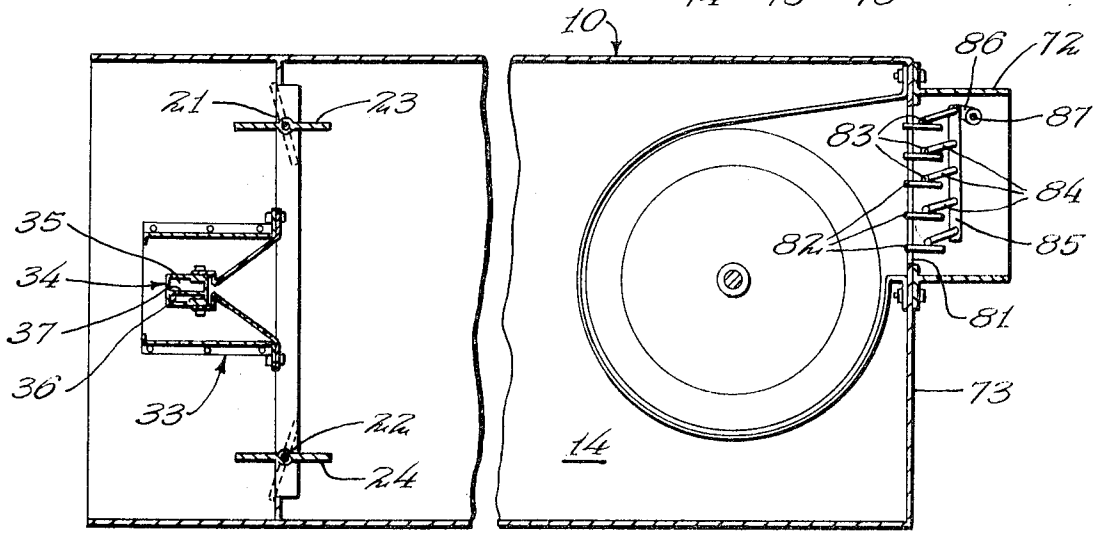


FIG. 2

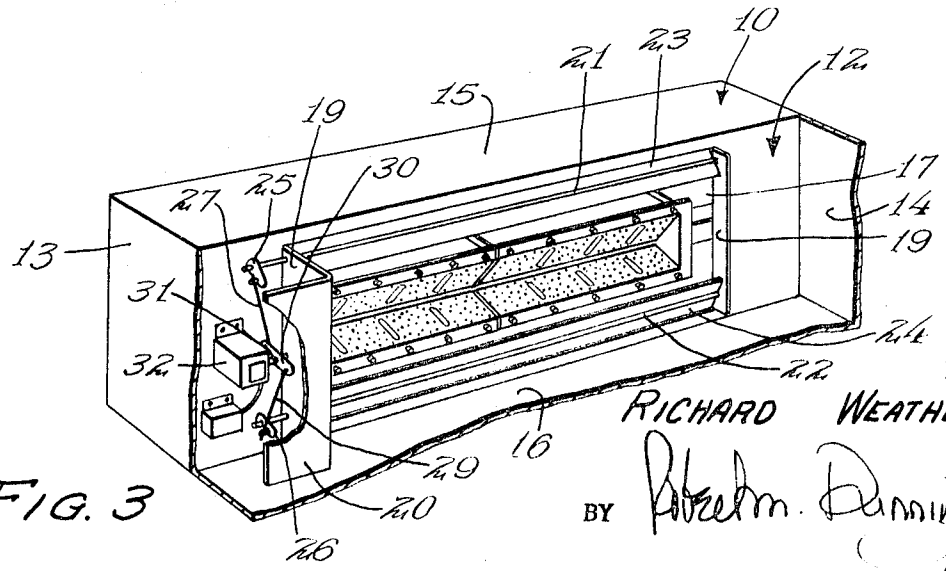


FIG. 3

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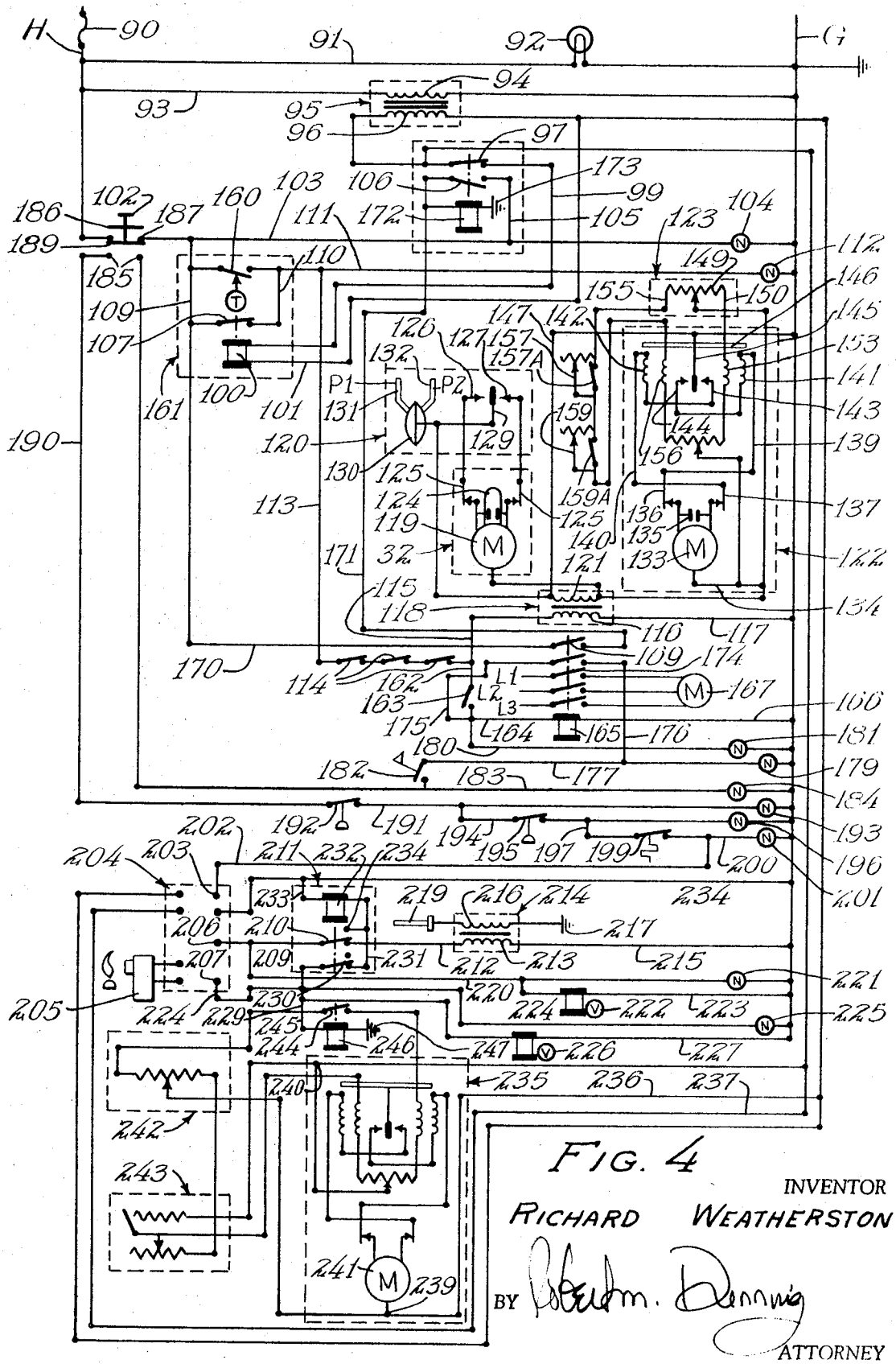


FIG. 4

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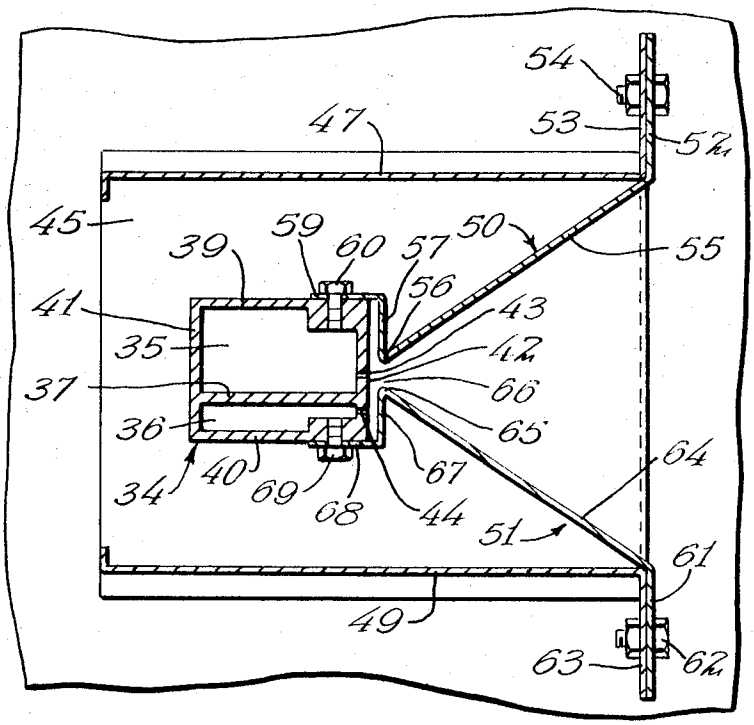


FIG. 5

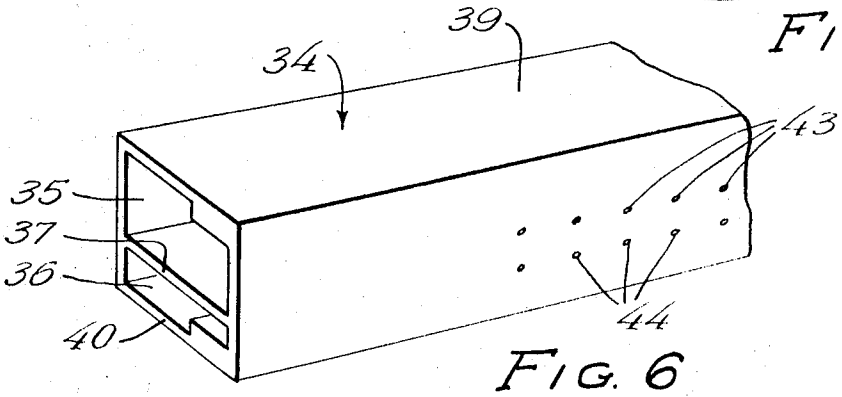


FIG. 6

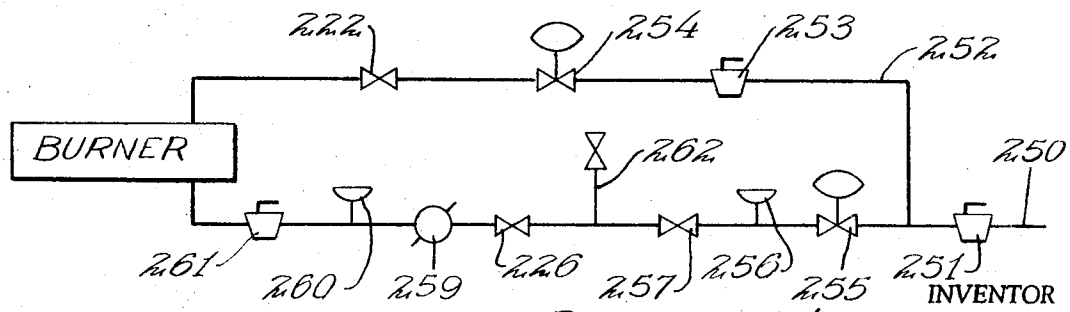


FIG. 7

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GAS FURNACE

This invention relates to an improvement in gas furnace and deals particularly with a furnace which is very efficient, and which is capable of maintaining a pressure differential on opposite sides of the heater unit so that the proper amount of air is supplied to provide complete combustion depending upon the air required to heat the area to be heated.

A feature of the present invention resides in the provision of a furnace which includes a closed cabinet, one end of which is preferably supplied with fresh air externally of the building or area being heated. The entering air moves past a heater element to which gas is supplied as the fuel being expended, and where air is proportioned in sufficient quantity to mix with the gas to cause virtually complete combustion. The amount of air being exhausted from the unit depends upon the amount of air which is required to produce the necessary heat for heating the area. In the present arrangement, the heated air leaving the heating unit is controlled by dampers which may be manually controlled by adjustable control means, or which may be automatically controlled in the event the area being heated is subject to the operation of exhaust fans which divert a portion of the air to the outer atmosphere. In other words, if the area being heated includes spray paint booths or similar areas from which the air must be evacuated to outer atmosphere, the outlet dampers may, if desired, by controlled to replace the air removed with heated incoming air by operating these outlet dampers.

A feature of the present invention resides in the provision of a heater element capable of admitting air, and profile dampers capable of admitting unheated air about the periphery of the heater. The pressure differential on opposite sides of the burner is maintained in such a manner that if a relatively small volume of heated air is required, the profile dampers will tend to open so that a greater amount of unheated air is admitted to mix with the heated air leaving the furnace.

A further feature of the present invention resides in the provision of a device of the type described in which air may be circulated through the furnace to the building to provide ventilation thereto when no heat is required. The arrangement is such that when no heat is required, air may be circulated from the outer atmosphere to the building through the furnace unit without requiring the intermediate heating step.

The exhaust conditions in modern plants are constantly changing. Factors that effect the amount of fresh air needed to replace the exhausted air are wind direction, temperature, the condition of the filters, and the number of exhaust fans being used. The present device is designed to assure the right amount of air at all times. The present device employs a constant speed drive including the burner unit through which a desired amount of air may flow from which the air may be discharged into the area to be heated. The discharge or volume dampers regulate the total amount of air delivered by changing the resistance in the system.

The dampers which are located above and below the burner compensate for the change in air flow across the burner, and these dampers open or close to maintain maximum combustion efficiency. In the present arrangement, it is possible to preset or dial any volume if air desired from the discharge dampers from 30 percent of capacity to one hundred of capacity of the air-circulating fans.

When the amount of air being delivered to the area to be heated changes, so does the airflow and pressure drop across the burner. The present device operates at its peak efficiency with 0.22 inches of air resistance across the burner. A sensitive constant controller detects the change in airflow and automatically resets the profile damper plates which are above and below the burner unit, to insure maximum combustion efficiency.

The profile dampers positioned by the constant pressure control also compensate for clogged filters that create added resistance, wind direction that effects the amount of air being handled, and compensate for pressure changes caused by varying burner efficiency at all times. As a result, the device cuts heating and electrical cost, and allows control to be effectively maintained.

These and other objects and novel features of the present invention will be more clearly and fully set forth in the following specification and claims.

In the drawings forming a part of the specification.

FIG. 1 is a plan view of the furnace showing the general arrangement of parts therein.

FIG. 2 is a vertical sectional view through the furnace unit, the position of the section being indicated generally by the line 2–2 of FIG. 1.

FIG. 3 is a perspective view of the burner unit.

FIG. 4 is a wiring diagram showing the manner in which the device functions.

FIG. 5 is a cross-sectional view through the burner.

FIG. 6 is a perspective view of one end of the burner extrusion before the sealing end plates are attached thereto.

FIG. 7 is a diagrammatic view of the gas system of the burner feeding gas to the pilot and main burners.

FIG. 1 of the drawings indicates a generally rectangular outer housing **10** which is connected at its inlet end with a filter section **11** through which the incoming air may flow. While the inlet end of the furnace housing is shown as being open, this end of the furnace is usually connected by suitable duct work to the outer atmosphere so that the air entering the furnace is normally outside air drawn from the exterior of the building to be heated.

As is indicated in FIGS. **1** and **3** of the drawings, a panel **12** extends across the furnace housing between the sidewalls, between the sidewalls **13** and **14** thereof, and between the top wall **15** and bottom wall **16**. The panel **12** is apertured as indicated at **17**, and a flange **19** which extends parallel to the sidewalls **13** and **14** extends forwardly from the panel **12** on one side of the aperture **17**, and a flange **19** extends forwardly from the panel **12** along the opposite side of the aperture **17**. The flange **19** preferably is provided with a right angularly extending baffle flange **20** which is directed toward the sidewall **13** and acts to protect the profile damper motor and the pressure sensor from direct contact with the heated air.

A pair of shafts **21** and **22** extend transversely across the apertures **17** near the upper and lower edges thereof respectively. These shafts **21** and **22** support profile dampers **23** and **24** respectively which are rotated in unison by the damper motor. Crank arms **25** and **26** are provided on the shafts **21** and **22** respectively, and these crank arms are connected by links **27** and **29** to an arm **30** mounted upon the drive shaft **31** of the profile damper motor **32**. Rotation of the drive shaft **31** in one direction tends to pivot the dampers **23** and **24** into substantially parallel relation to the vertical panel **12**. Rotation of the drive shaft **31** in the opposite direction is capable of moving the dampers **23** and **25** into fully open position at right angles to the vertical position thereof. The position of the dampers **24** and **24** determines the proportion of air entering the housing **10** which passes through the heater unit which is indicated in general by the numeral **33** to the total amount of air circulated.

The burner element includes an elongated extrusion **34** which is supported by suitable bracket means, not illustrated in the drawings, by the sidewalls **13** and **14** of the housing **10**. The extrusion **34** is of generally rectangular cross section and is hollow, (See FIGS. **5** and **6**), the extrusion including an upper manifold **35** and a lower manifold **36** separated by a partition wall **37**. As is indicated in FIGS. **5** and **6** of the drawings, the extrusion **34** includes substantially parallel top and bottom walls **39** and **40**, a rear wall **41**, and a front wall **42**. The downstream side of the burner element is provided with a row of openings **43** which communicate with the upper manifold **35**, and a second row of apertures **44** which are in communication with the lower manifold **36**. Gas supply lines such as **45** supply gas to the upper manifold **35** while a similar gas supply line is connected to the lower manifold **36**. The gas

in the manifold 36 is normally under relatively low pressure and the gas leaving the manifold 36 through the outlet apertures 44 are normally of low flame capacity and serve mainly as pilot burners for the gas flowing through the discharge openings 43 connected to the upper manifold 35. The gas flowing through the upper manifold 35 is under relatively high pressure, and is normally turned on and off intermittently to heat the air flowing from the furnace.

As indicated in FIGS. 1 and 5 of the drawings, the extrusion 34 supports a pair of parallel end panels 45 and an intermediate partition plate 46. Top panels 47 and a bottom panel 49 combine with the end plates 45 and partition plate 46 to provide a generally rectangular passage way, the top and bottom walls of which are in spaced relation to the extrusion 34. A pair of apertured of foraminous baffle plates 50 and 51 are provided on the downstream side of the extrusion 34. Each baffle 50 includes a vertical flange 52 which is bolted or otherwise secured to the front flange 53 of a corresponding top panel 47 by bolts 54 or other suitable means. The baffle 50 includes an inclined portion 55 which is directed toward the vertical center of the wall 44 of the extrusion and which is connected at its lower end 56 to a vertical flange 57 in spaced relation to the wall 42 of the extrusion 34. The vertical wall 57 terminates in a horizontal flange 59 which extends over the top wall 39 of the extrusion 34 and is secured thereto by bolts 60 or other suitable means.

In a similar manner, the baffle 51 includes a downwardly extending vertical flange 61 which is secured by bolts or other suitable means to the downturned vertical flange 63 of the bottom panel 49. The flange 61 is connected to an inclined portion 64 which is directed toward the vertical center of the extrusion side 41 and terminates in an edge 65 which is in spaced relation to the upper baffle end 56 to provide a throat 66 therebetween. A downturned vertical flange 67 which is in spaced relation to the wall 42 of the extrusion 34 terminates in a horizontal flange 67 which extends beneath the wall 40 of the extrusion 34 and is secured in place by means of capscrews 69 of other suitable means.

The flames caused by ignition of the gas passing through the apertures 43 communicating with the upper manifold 35 directed through the throat 66 between the baffles 50 and 51, and air forced through the apertures in the baffles 50 and 51 combine with the gas to insure complete combustion thereof. The flame heats the air as it is drawn through the furnace housing.

It will be noted that the apertures 44 which communicate with the low pressure manifold 36 terminate inwardly of the vertical flange 67 of the lower baffle 51 so that the flames issuing from these apertures 44 are confined between the baffles and the extrusion.

The air is drawn through the housing 14 by means of a pair of axially spaced fans 71 which draw air from the housing 14 and direct the air through transversely elongated generally rectangular tubular outlet passages such as 72 mounted on the wall 73 at the discharge end of the furnace housing. The fans 71 are driven by any suitable means, and are shown as mounted upon a common shaft 74 having a pulley or sprocket 75 thereon which is connected by a suitable belt or chain 76 to a cooperable pulley or a sprocket 77 on the drive shaft 79 of the drive blower motor 80. This arrangement may be indicated in FIG. 1 of the drawings.

Each tubular outlet 72 communicates with an outlet aperture such as 81 in the housing panel 73. Each of the tubular outlets 72 is provided with a series of louvers 82 mounted on parallel shafts 83 between the opposite sides of the tubular members 72. Arms 84 which rotate with the louvers 82 are hingedly connected to a vertical link 85 to insure of pivotal movement of the louvers from open to closed position in unison. The operating link 84 is connected to a crank arm 86 pivotally supported at 87 and connected by suitable linkage to a discharge damper motor 87 located between the outlet passages 72 as indicated in FIG. 1 of the drawings. In view of the fact that the manner in which a reversible motor such as 87 may drive a shaft 87 to rotate the crank arm 86 in either direction is well known in the art, the detail of this structure is not indicated. However, as an example, the motor 87 may be connected by belt or chain means to a pulley or sprocket on the shaft 87 to slowly rotate the shaft in either direction. By operation of the motor 87, the outlet or discharge dampers may be rotated from a fully closed position to a fully open position in which the louvers are parallel to the direction of flow of air through the outlet passages.

The circuit by means of which the present device is operated is best illustrated in FIG. 4 of the drawings. As is indicated in this figure, a circuit of generally 110—120 volts is indicated with line wires H and G representing what is normally known in the trade as the hot line and the ground wire. The hot line H is provided with a fuse 90 to protect the circuit. Beyond the fuse 90 from the current supply source, a conductor 91 connects the line wires H and G including a signal light 92 which indicates that the power is on, and which is illuminated when the circuit is energized through a suitable main switching arrangement which is not illustrated in the drawings.

A conductor 93 extends from the line wire H to line wire G and includes a transformer coil 94 of a transformer 95. The transformer 95 is designed to transform the voltage from 110 volts between the line wires H and G to a lower voltage such as 24 volts in the secondary coil 96. One terminal of the coil 96 leads through a normally closed switch 97 to a conductor 99 leading to a time delay relay coil 100, the other terminal of which is connected by conductor 101 to the opposite side of the transformer secondary 96. In actual practice, the time delay relay comprises a warp switch which opens after a predetermined length of time. However, a time delay relay which accomplishes the same result is illustrated.

The line wire H is directed to a manually operable switch 102 which may be positioned in the relation shown in FIG. 4 during the summer months, and which may be positioned in an alternate position during the winter months. In the particular arrangement illustrated, the switch 102 is in the summer position and closes a circuit from the line wire H to the conductor 103. The conductor 103 is connected through a signal light 104 to the line wire G to indicate that the circuit is closed. The conductor 103 also leads to a low limit relay switch 106. The purpose of this arrangement will be later described.

As soon as the relay coil 100 is energized, a switchblade 107 is closed closing a circuit from conductor 103 through a conductor 109 and the switch 107 to a conductor 110 leading to conductor 111 leading through a low limit signal light 112 to the line wire G. The closing of the switch 107 also closes a circuit from line wire G. The closing of the switch 107 also closes a circuit from line wire H, the conductor 109, switch 107, conductors 110 and 111 to a conductor 113 leading through a series of overload switches 114 to a conductor 115 connected to the primary of a transformer coil 116, of a transformer 118 the other terminal of which is connected by conductor 117 to the line wire G. Thus the closing of the switch 107 automatically energizes circuits leading to a differential pressure switch 32 designed to control the position of the profile dampers on opposite sides of the burner units, and a damper motor 122 designed to control the position of the discharge dampers of the device. The damper motor 32 which controls the profile dampers may be the type known as motor M 604C produced by Honeywell of Minneapolis, Minnesota. The control unit 120 for the motor 119 is operated by differential pressure on opposite sides of the burner, and the numeral 120 indicates a differential pressure switch used to control the motor 119.

The transformer 118 includes a secondary coil 121 which also controls the damper motor used to control the dampers at the discharge of the device. The motor 122 is a reversible type motor controlled by a potentiometer 123. The various other components of the circuit will be later described. In view of the fact that the switch 102 is indicated in the position to control the flow of unheated air during the summer time, this arrangement will first be described.

The motor 32 drives a rotatable shaft 124 which may eventually actuate either of a pair of limit switches 125. The coils of the motor are connected through these limit switches 125 to contacts 126 and 127 which may be engaged by a movable contact 129 actuated by the diaphragm device 130 which is subjected to the pressures P1 and P2 connected by conduits 131 and 132 to opposite sides of the burner element. In other words, when the differential pressure exceeds certain limits, the movable contact 129 will engage one of the fixed contacts 126, 127 to move the motor 32 an angular distance sufficient to change the differential pressure in the sensing unit 130 and to once again center the contact 129 between fixed contacts 126 and 127. On the other hand, if the differential pressure on opposite sides of the burner unit decreases sufficiently, the movable contact 129 will engage the opposite of the contacts 126, 127, and call for a reversal of the motor 32. As will be understood, movement of the motor 32 controls the opening and closing of the profile dampers 23 and 24.

The motor unit controlling the outlet dampers 82 is indicated in general by the numeral 87. The motor unit 87 includes a rotatable motor unit 133, one terminal of which is connected by conductor 134 to the current supply. A condenser 135 is connected across the remaining motor terminals, and these remaining terminals are connected through limit switches 136 and 137 to conductors 139 and 140 which extend through coils 141 and 142 to a pair of contacts 143 and 144 on opposite sides of an armature 145. The armature 145 is controlled by movements of the plate 146. The armature 145 is connected by a conductor 147 to one side of the transformer secondary 121.

The movement of the motor element 133 is controlled by the potentiometer 123 including a resistance coil 149, one terminal of which is connected by the conductor 150 to a coil 153 controlling the position of the plate 146 in a manner to move the contacts 145 into engagement with the contact 144. The other end of the potentiometer coil 149 is connected by a conductor 155 to a coil 156 which tends to move the member 146 in the opposite direction and to cause the contact arm 145 to engage the contact 143. The conductor 155 leads through a pair of auxiliary potentiometers 157 and 159 which will be later described.

A temperature actuated low limit switch 160 is arranged in shunt relation to the time delay relay switch 107. The low limit switch 160 is set to open when the temperature of the incoming air is lower than a predetermined minimum such as 40° F., and accordingly is closed during warmer weather. When the device is being used to circulate air during summer weather, the circulating fans should not function if the outside temperature is below a minimum of perhaps 40° F. However, the switch 160 is normally closed when the temperature is above the minimum desired. It should be explained that means are provided for holding the switch 160 closed in the event the furnace is started in extremely cold weather. Once the furnace has been started, the interior of the housing is maintained above the low limit temperature.

The circuit from line wire H passing through either of the switches 107 or 160 of the time delay relay 161 flows through the conductor 113 and the overload switches 114 to a conductor 162 leading to the damper end switch 163. The louvers 82 of the outlet damper normally close when the operating motor 122 is deenergized. As soon as current flows through the conductors 115—117, the transformer coil 116 supplying current to the motor 122, the louvers swing toward partially open position as determined by the potentiometer 123. The damper end switch 163 is physically closed by the partial opening of the damper louvers, closing a circuit to the conductor 164 leading to the relay coil 165, the other terminal of which is connected by the conductor 166 to line wire G. The energization of the solenoid coil 165 closes a series of three starter motor switches leading to the blower motor 167 form the line wires L1 L2 and L3. A first auxiliary switch 169 is also closed, and a circuit is provided from a conductor 170 connected through the switch 102 to line wire H and to a conductor 171 leading to allow limit relay 172, the other terminal of which is grounded at 173. Energization of the relay coil 172 functions to open the switch 97 in the circuit leading to the time delay relay and to close the switch 106 connecting the relay coil 172 through conductor 105 to the conductor 103. Thus the switch 106 closes a holding circuit for the relay coil 172 and this coil remains energized as long as the auxiliary switch 169 controlled by the motor-starting relay 165 is closed.

A secondary auxiliary switch 174 is closed by the motor relay coil 165, closing a circuit from the conductor 164 through a conductor 175 and a conductor 176 to a conductor 177 leading to ground wire G through an indicating light 179 which indicates that the blower is in operation. A conductor 180 is also connected to the conductor 164 and leads through an indicator light 181 to the ground line G indicating that the dampers and damper motor 122 are in operation.

An additional element which functions is an air switch 182 connected between the conductor 177 energized by the closing of the second auxiliary switch 174 and which closes a circuit to the conductor 183 connected to the ground line G through an indicating light 184 which indicates that air is flowing through the furnace. The remainder of the circuit is broken between contacts 185 of manual switch 102. During winter weather, when the device is to function as a furnace, the switch 102 is moved downwardly from the position shown in FIG. 4 of the drawings so that the upper conductor 186 closes the contacts 187 previously connected by the switch blade or switch element 189, and the switch blade 189 connects the contacts 185. This closes a circuit to a conductor 190 leading to the remainder of the furnace apparatus circuit. The conductor 190 is connected to a conductor 191 through a normally closed low gas switch 192 which is opened only when the gas pressure is too low to support combustion. The conductor 191 is connected to the line wire G through a low gas indicator light 193.

A conductor 194 is connected to the conductor 191 to the line wire G through a normally closed high gas switch 195 and an indicator light 196 indicating that the pressure in the gas line is not excessive. The switch 195 is only opened when the gas pressure exceeds a predetermined maximum.

A conductor 197 is connected to the conductor 194 between the high gas switch 195 and the indicator light 196 and extends through a high limit switch 199 to a conductor 200 leading to the line wire G through an indicator light 201 indicating that the high limit switch 199 is closed. A conductor 202 is connected to the conductor 200 and supplies current through a terminal 203 of a commercial flame safeguard control which is shown diagrammatically in the drawings. The control 204 comprises a UVM-1 control produced by the Combustion Control Division of the Electronics Corporation of America located at Cambridge, Mass. Alternatively, the control 204 may be a somewhat similar control produced by Minneapolis Honeywell of Minneapolis, Minnesota known as Control R 890 G. The control 204 is connected to a scanner 205 capable of determining the presence of ignition flame to provide the presence of flame through the use of an ultraviolet sensitive gas discharge tube and which opens the circuit to the main gas valve and to the pilot valve in the event no flame is detected after predetermined time interval. The control 204 closes an internal circuit from the power terminal 203 to a terminal 206 connected by conductor 209 to the relay switch 210 of a nonrecycling relay 211 to a conductor 212 leading to the primary coil 213 of an ignition transformer 214. The other transformer coil is connected through conductor 215 to ground wire G.

The secondary coil 216 of the ignition transformer 214 has one end grounded as indicated at 217, and extends to a spark plug 219 capable of igniting the gas for the furnace.

The terminal 206 of the control 204 is also connected by a conductor 200 connected to the ground wire 6 through the signal light 221. The conductor 220 is designed to energize the pilot valve 222 connected through conductors 223 to ground wire G. Thus the pilot valve 222 is opened simultaneously with

the operation of the ignition spark plug 219, and functions to turn on the pilot flames and to ignite the gas.

When a flame is detected by the scanner 205, a circuit is closed from the power terminal 203 of the control 204 to the terminal 207 through an internal circuit. The terminal 207 is connected by a conductor 224 leading to an indicator light 225 which is also connected to the ground wire G. The coil of a main gas solenoid valve 226 is connected in parallel with the detector light 225 by conductor 227 and is energized when the terminal 207 is energized.

A conductor 229 is connected to the terminal 207 through a portion of the conductor 224 and leads through a normally closed relay switch 230 through a conductor 231 leading to the coil 232 of the nonrecycling relay 211. The other terminal of the coil 232 is connected by conductors 233 and 234 to ground wire G. Thus the relay 232 is energized when flame is detected by the sensor 205 opening the circuit to conductor 212 leading to the ignition transformer and closing a circuit to a contact 234 leading through the relay coil 232. Once the relay disengages the ignition transformer 213, it must be manually reset.

The power transformer 95 which is connected between the line wires H and G has its secondary coil 96 connected by conductors 236 and 237 to terminals 239 and 240 of a modulating control motor 235 which may be of the type designated as M 931 C made by Minneapolis Honeywell of Minneapolis, Minnesota. The reversible motor element 241 of this motor opens and closes a valve in the main gas line so as to increase and decrease the flow of gas to the burners depending upon existing conditions. The motor unit 235 is controlled by a remote bulb proportional temperature controller produced by Minneapolis Honeywell of Minneapolis, Minnesota. The flow of gas is also controlled by a proportional control 243 of the type known as a T92 A thermostat which is also produced by Minneapolis Honeywell. In view of the fact that these devices are well known in the art, it is believed sufficient to say that the flow of gas through the main valve to the burners is regulated by the units 242 and 243 to provide a proper flow of gas and to produce a desired ambient temperature.

The motor unit 235 and its controls 242 and 243 are set into operation by means of a switch 244 in the motor and control circuit. A conductor 245 leading to the conductor 244 and through which current flows when the scanner 205 indicates the presence of a flame closes the circuit to a relay coil 246 the other terminal of which is grounded at 247. Activation of the coil 246 closes the switch 244 to set the motor unit 235 and its controls in operation.

For the purpose of identification, it should be noted that the motor 122 which controls the dampers in the discharge of the furnace may be of the type known as M905 E also produced by Minneapolis Honeywell Obviously, equivalent units could be employed.

FIG. 7 of the drawings indicates diagrammatically the arrangement of valves in the gasline. The gas supply line 250 includes a manually operable plug valve 251 which may close off the entire system. A bypass line 252 provides a gas supply to the pilot burners through a plug valve 253 and a pressure regulating valve 254. The low pressure gas passing through the valve 254 passes through the solenoid valve 222 and to the pilot manifold of the burner.

The operation of the device is believed quite evident from the foregoing description. During the summertime, when it is desired to circulate outside air through the area to be heated, the switch 102 is positioned in its elevated position shown, bridging the contacts 187. Current flows through the transformer 95 and a circuit is closed through the switch 97 of the low limit relay to the time delay relay coil 102. A circuit is then closed from line wire H through the switch 102 and switch 107 of the time delay relay through the conductor 113 and the normally closed overload switches 114 to the conductors 115 and 117 completing the circuit to the transformer 118 providing power to the discharge damper motor 122 and the profile damper motor 32. The motor 122 moves the dampers from their normally closed position to a position as determined by the setting of the potentiometer 123. When the louvers 82 of the discharge dampers open a predetermined amount, the damper end switch 163 is closed completing a circuit to the motor starting relay 165 which starts the blower motor 167 into operation. The closing of the blower motor starter switch also closes an auxiliary switch 169 completing a circuit through a switch 102 from line wire H through conductors 170 and 171 to a low limit relay coil 172. This opens the circuit to the time delay relay coil 100 and closes a holding circuit which maintains the relay 172 energized as long as the blower motor is in operation. The second auxiliary switch 174 closes a holding circuit to the motor-starting relay 165 maintaining the blower motor in operation as long as the overload safety switches 114 and the thermostatically operated switch 160 are closed.

The discharge dampers are usually maintained at a position as set by the potentiometer 123. However, if desired, remote control switches 157 A and 159 A may be provided in the potentiometer circuit. These switches are normally closed, but may if desired be open in the event either or both of a pair of exhaust fans are turned on to exhaust air from the building. In the event either or both of the switches 157 A and 159 B are opened, the current to the potentiometer 123 is varied, and the dampers are open to a greater extent increasing the flow of air from the blowers. The profile dampers are automatically operated by the damper motor 32 and the pressure controller 122 to provide the proper flow according to the pressure drop on opposite sides of the burner.

During winter weather, the switch 102 is adjusted in position forming contact between the blower section of the furnace and the heating section thereof. This connection extends through the conductor 177, switch contacts 185 and conductor 190. In order to actuate the burner circuit, it is necessary that the low gas switch 192, the high gas limit switch 195, and the high limit switch 199 be closed. It is also necessary that the blower motor be functioning, as determined by the air flow switch 182. Current then flows through the conductor 202 to the flame safeguard 204 and to the contact 206 through the interior wiring. From the contact or terminal 206, the current flows through conductors 220 and 223 to the pilot valve 222 which opens the flow of gas to the pilot valve manifold. Simultaneously current flows through the relay switch 210 to the ignition transformer 214 which fires the spark plug 219. This circuit remains closed for a predetermined length of time. If the scanner 205 detects flame, a circuit is also closed from the terminal 203 through the interior wiring of the device 204 to the terminal 207. This closes a circuit through the conductors 224 and 227 to the main gas solenoid 226 which opens this gas valve and allows gas to flow to the high pressure gas manifold within the burner.

Simultaneously, with the closing of the main gas valve 226, a circuit is closed through conductor 229 and relay switch 230 to conductors 231 leading to the relay coil 232, the other terminal 233 of which is connected by conductor 234 to line wire G. Energization of the relay coil 232 opens the circuit to the ignition transformer 213, and closes a holding circuit through the relay switch 210 and conductors 231 to the relay coil 232, providing a holding circuit which locks in place. Due to the fact that during the winter weather, the furnace pilot lights remain on constantly the relay 211 is arranged for manual reset once the furnace has been turned off. The gas flow to the high pressure manifold of the burner is controlled by modulating motor 241. This motor opens and closes the valve in response to actuations to the proportional temperature controller 242 and the thermostat 243 supplied more or less gas to the burner in response to the demands.

I have described the principles of construction and operation of my improvement in gas furnace, and while I have endeavored to set forth the best embodiment thereof, I desire to have it understood that changes may be made within the scope of the following claims without departing from the spirit of my invention.

I claim:

1. A gas furnace including:
a furnace housing having an air inlet and an air outlet
means for circulating air through said housing,
damper means controlling the flow of air from said outlet,
a burner secured within said housing adjacent to said inlet,
profile damper means in said housing for controlling the proportion of air passing through said housing which bypasses said burner, and
differential pressure actuated means connected to said profile dampers and operable to maintain a predetermined differential pressure on opposite sides of said profile dampers.

2. The structure of claim 1 and in which said burner comprises an elongated burner manifold, and in which said profile damper means are mounted above and below said burner manifold.

3. The structure of claim 1 and in which said air circulating means is in said housing.

4. The structure of claim 1 and in which said damper means controlling the flow of air from said outlet is normally closed unless said air-circulating means is in operation.

5. The structure of claim 1 and including remote control means for regulating the position of said damper means controlling the flow of air through said outlet.

6. The structure of claim 5 and including auxiliary means for opening said damper means controlling the flow of air from said outlet.

7. The structure of claim 1 and including means preventing the operation of said air circulation means in the event the incoming air is below a predetermined minimum temperature.

8. A gas furnace including:
a furnace housing having an air inlet and an air outlet,
means for circulating air through said housing,
damper means controlling the discharge of air from said outlet,
a damper control motor for controlling the position of said damper means,
remote control means connected to said motor for adjusting the position of said damper means,
a burner in said housing adjoining the inlet end thereof including gas supply means providing fuel thereto,
profile damper means in said housing for controlling the flow of air which bypasses said burner,
second motor means connected to said profile damper means for opening and closing the same,
means actuated by differential pressure on opposite sides of said profile damper means connected to said second motor means and controlling the position of said profile dampers dependent upon the pressure on opposite sides thereof.

9. The structure of claim 8 and including a circuit to said air-circulating means for actuating the same, and means in said circuit operable when the air entering said housing goes below a predetermined minimum to open said circuit.

10. The structure of claim 8 and including an
auxiliary means for actuating said damper means controlling the flow of air from said outlet.

11. A gas furnace including:
a furnace housing including an air inlet and an air outlet,
means for circulating air through said housing,
a burner mounted near the inlet end of said housing and including a burner enclosure, a burner manifold extending across said enclosure, and foraminous baffle plates on either side of said burner manifold within said enclosure through which air may flow to support combustion,
damper means controlling the flow of air through said housing outlet,
profile damper means in said housing inlet regulating the proportion of air entering said housing which bypasses said burner enclosure,
means controlled by variations in differential pressure on opposite sides of said burner connected to said profile dampers to control the same.

12. The structure of claim 11 and in which said profile damper means are on opposite sides of said burner enclosure.

13. The structure of claim 11 and in which said burner enclosure are laterally elongated, and in which said profile damper means are above and below said burner enclosure.

14. The structure of claim 13 and in which said means controlled by variations in differential pressure operate said profile damper means in unison.

15. The structure of claim 11 and including remote controlled means for actuating said damper means controlling the flow of air through said outlet.