

Dec. 29, 1936.

H. V. LEAHY

2,065,533

FURNACE CONSTRUCTION

Filed Oct. 19, 1931

6 Sheets-Sheet 1

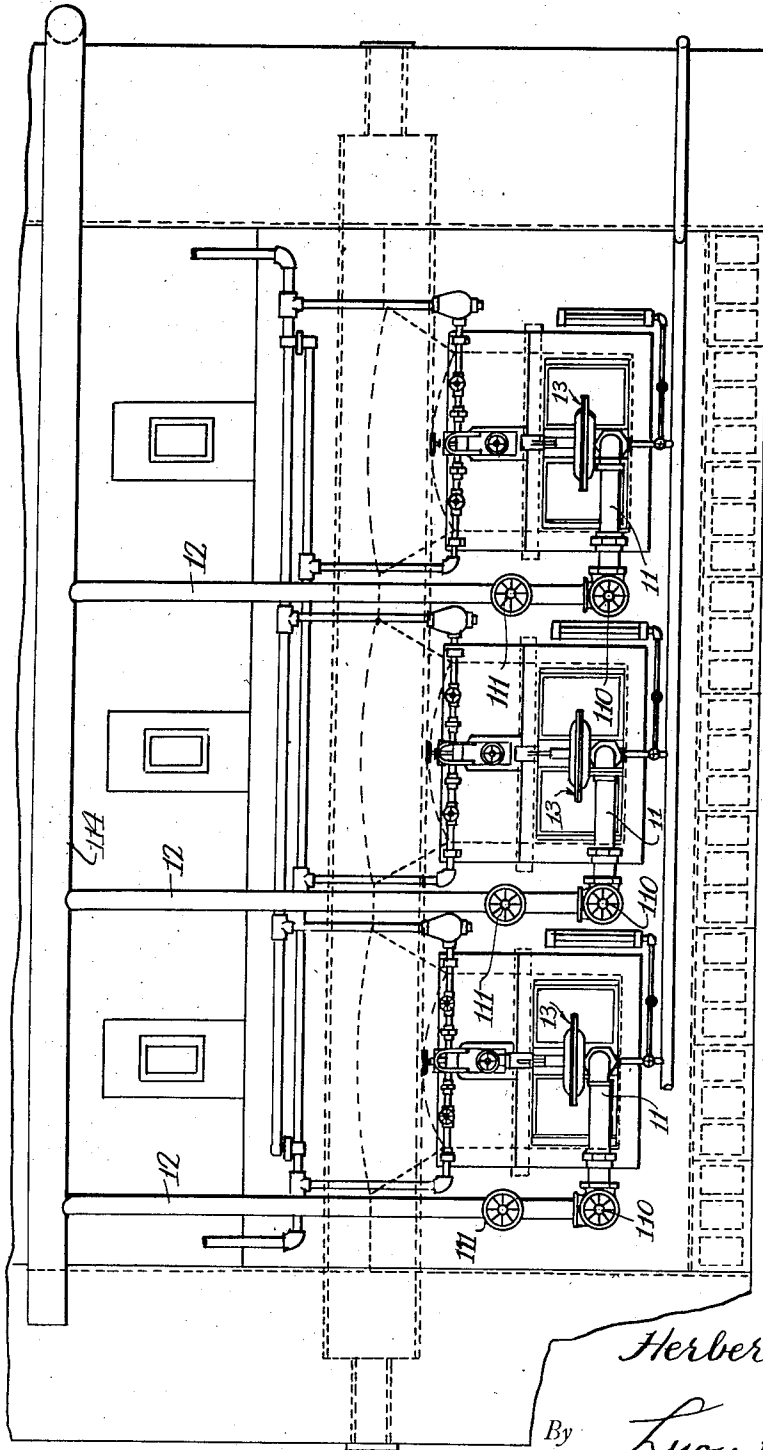


Fig. 1

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6 Sheets-Sheet 2

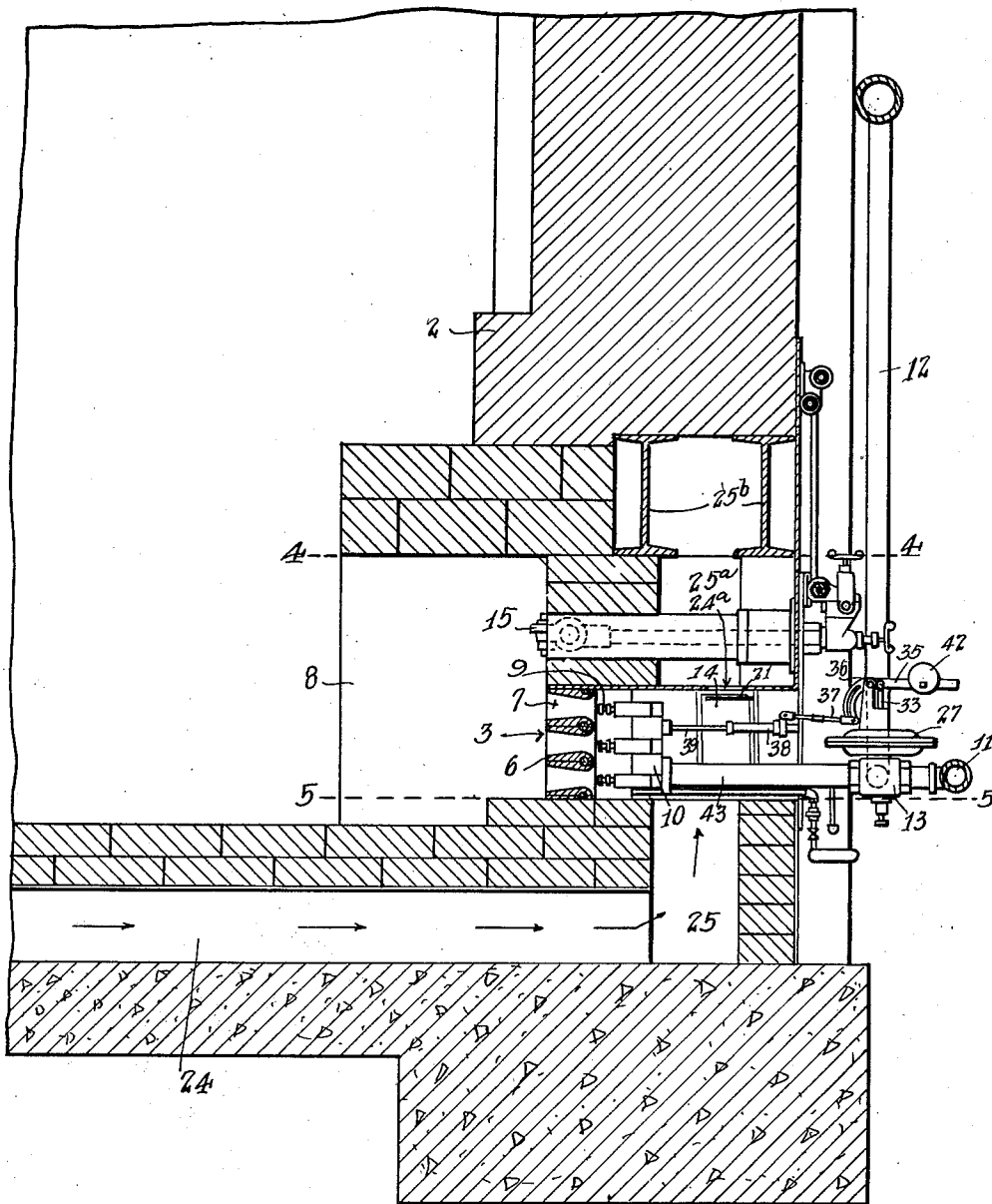


Fig. 2

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Fig. 3

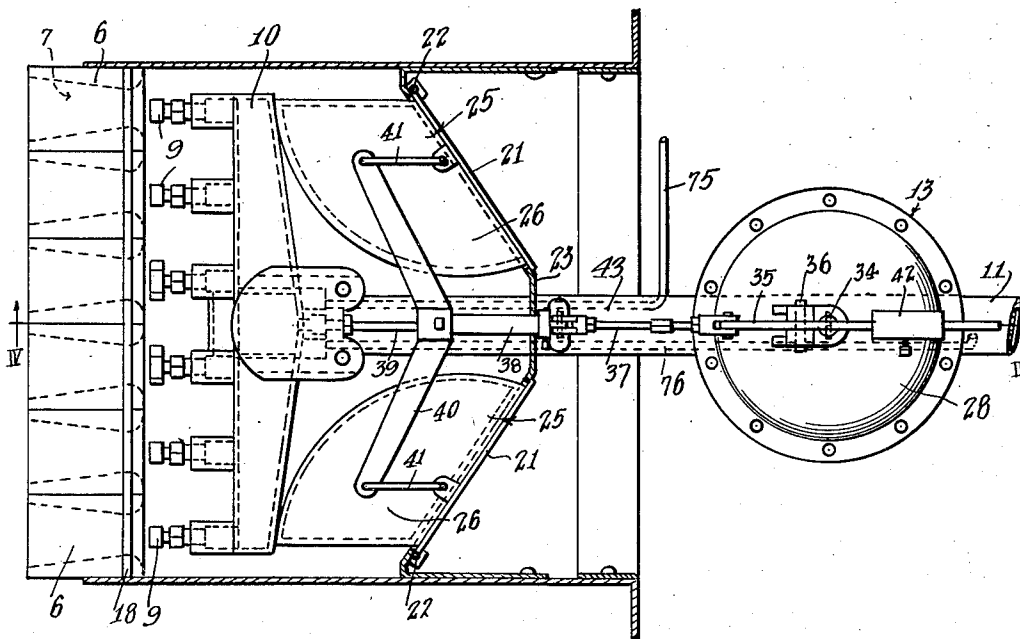
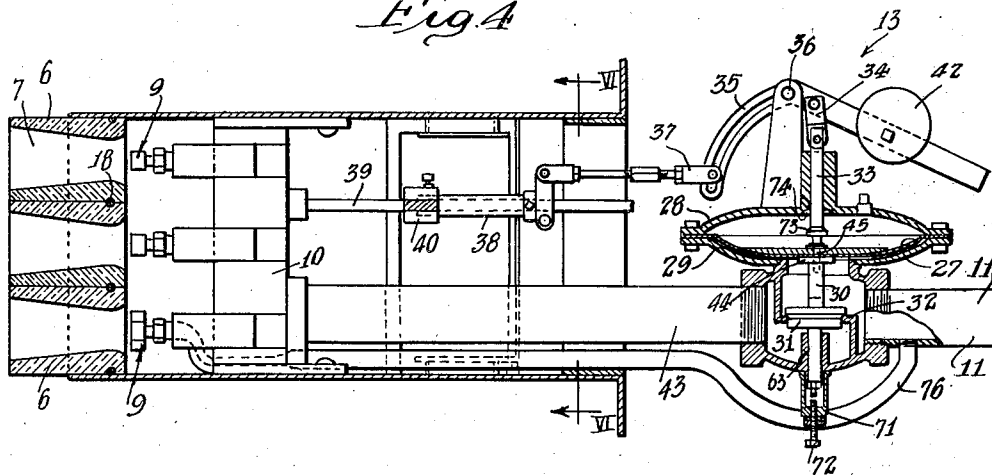


Fig. 4



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Fig. 5

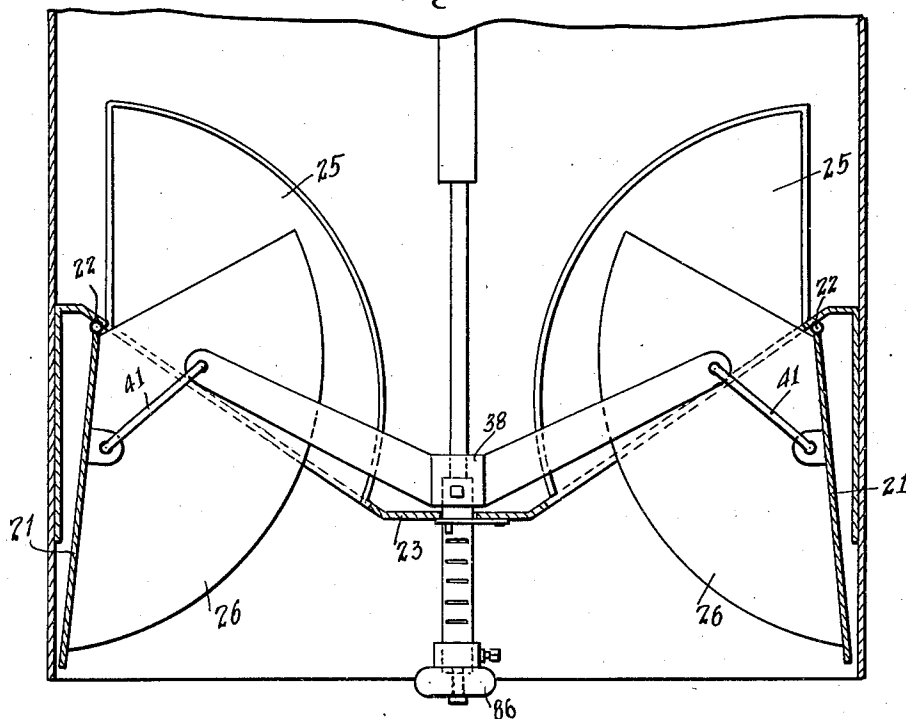
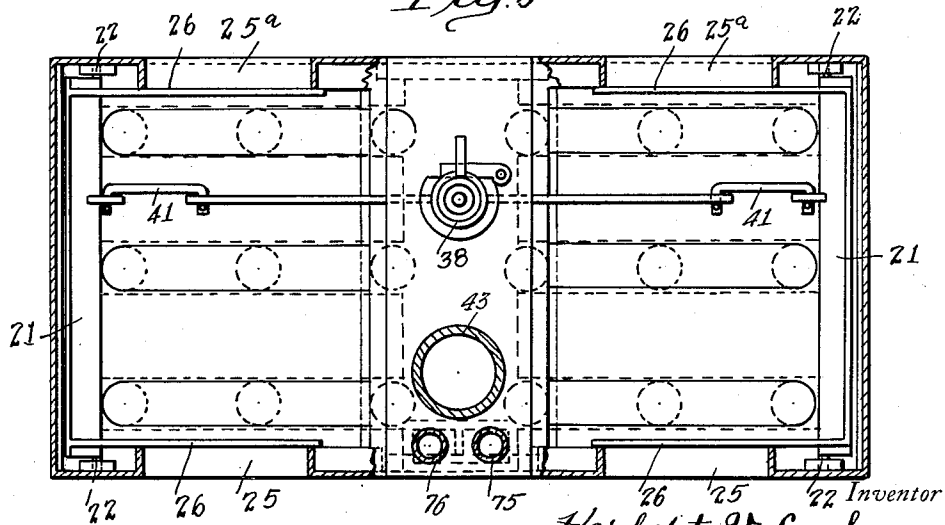


Fig. 6



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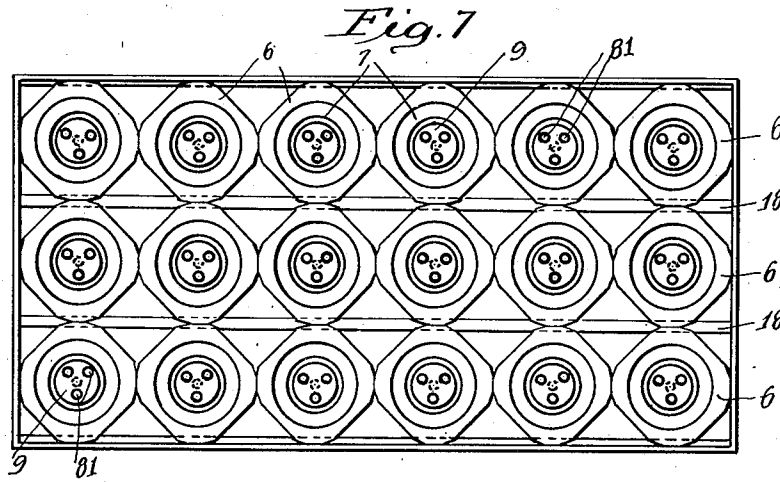
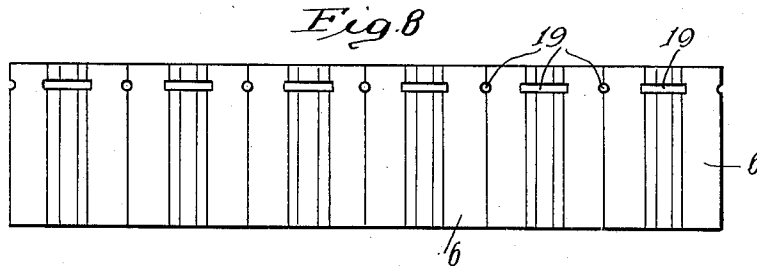
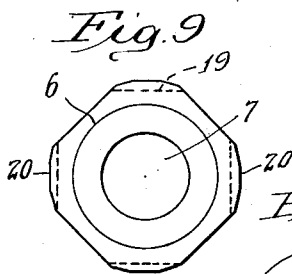
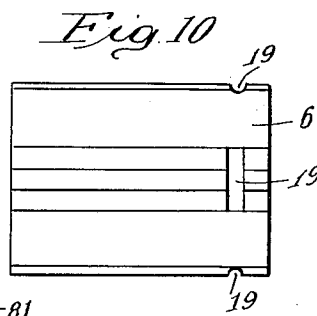
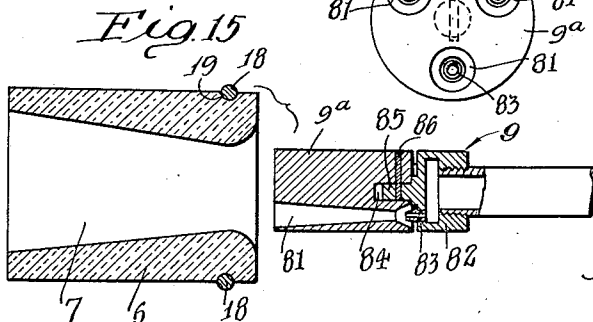
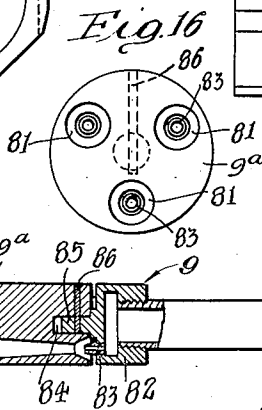
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Fig. 11

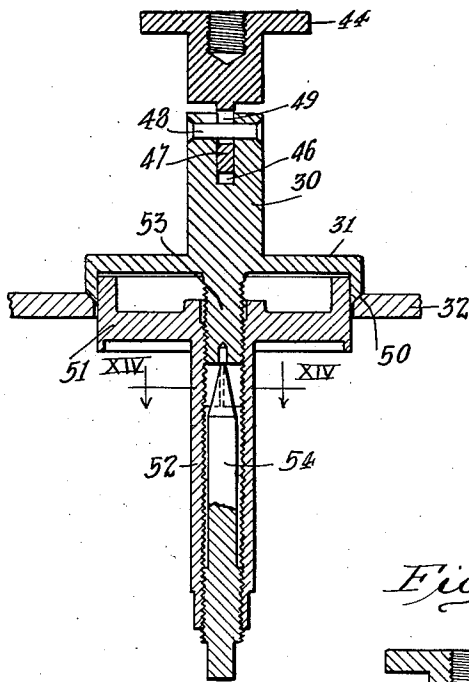


Fig. 12

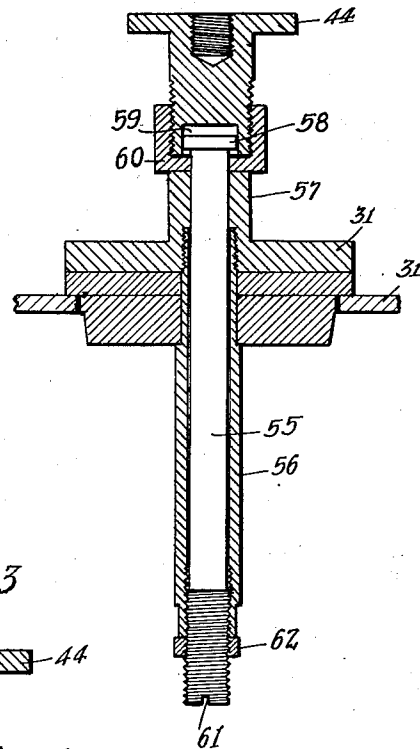


Fig. 13

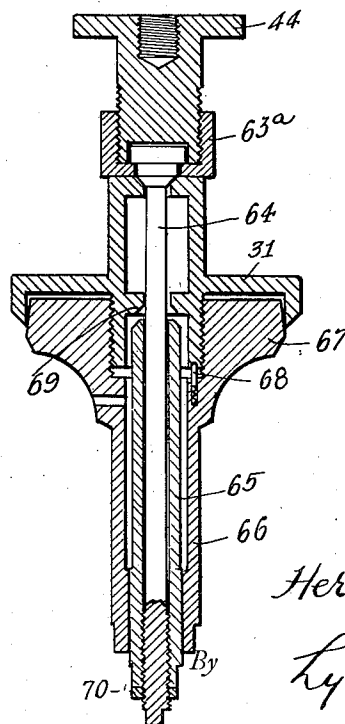
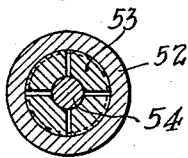


Fig. 14



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UNITED STATES PATENT OFFICE

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FURNACE CONSTRUCTION

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Application October 19, 1931, Serial No. 569,639

4 Claims. (Cl. 158—119)

This invention relates to gas burning devices, and particularly to furnaces utilizing gas as fuel.

An object of the invention is to automatically regulate the air supply to a gas furnace in proportion to the gas delivered.

Another object is to provide an automatic control equipment which may be readily adjusted for manual control in case of failure of the automatic control.

Another object is to prevent wastage of gas when the burner is operating under low gas pressure.

Another object is to provide draft doors for simultaneously regulating the admission of both cold and preheated air to the burner.

Another and more detailed object is to provide an automatic draft door, opening in response to the pressure of gas delivered to the burner, that will function to open the draft doors prior to the admission of gas to the burner.

Another object is to improve the efficiency of a gas burner.

Still another object is to simplify the assembly of a gas burner.

Other objects and advantages of the invention will be apparent from a detailed description of the invention when taken in conjunction with the drawings, in which

Figure 1 is a front elevational view of a furnace employing three burners in accordance with my invention;

Figure 2 is a vertical cross section of a portion of a furnace showing the general installation of my burner in the furnace;

Figure 3 is a plan view, partly in section, of one of the burners disclosed in Figure 1;

Figure 4 is a vertical section in the plane IV—IV in Figure 3;

Figure 5 is an enlarged sectional view of the door mechanism shown in Fig. 3, showing the doors in open position;

Figure 6 is a vertical section in the plane VI—VI of Fig. 4;

Figure 7 is an elevational view of the inside end of the burner as it would appear from the interior of the furnace;

Figure 8 is a horizontal section looking down on one of the horizontal rows of tiles shown in Fig. 7;

Figure 9 is a detail end view of one of the tiles shown in Figs. 7 and 8;

Figure 10 is a detail side view of one of the tiles shown in Figs. 7 and 8;

Figures 11, 12 and 13 are detail sections of dif-

ferent types of valves that may be employed in my burner;

Figure 14 is a section in the plane XIV—XIV of Fig. 11;

Figure 15 is an enlarged detail sectional view of one of the tiles and burner tips; and

Figure 16 is an end view of the burner tip shown in Fig. 15.

Referring to Fig. 2, a burner unit, designated generally at 3, is mounted in the front wall of a furnace setting. The front wall of the furnace above the line 4—4 and below the line 5—5, may be of any desired construction, the only requirement being that an opening be left between these lines in which to insert the burner. The gas burner is inserted in the lower part of the opening and comprises a wall of tiles 6, (a view of which as it appears from within the furnace is shown in Fig. 7), mounted one on top of the other to form a plurality of Venturi passages 7 leading into the combustion chamber 8. The detailed construction of the tiles forming these Venturi passages will be described later. Back of each Venturi passage 7 is positioned a burner nozzle 9 for delivering gas through the associated Venturi passage to the combustion chamber. Burner nozzles 9 are supported by a manifold 10 which is connected through a pipe 43 and an automatic valve 13 to a gas pipe 11. Draft doors 14 are placed back of the burners 9 for regulating the draft and admitting the optimum amount of air for complete combustion.

Oil burner 15 is positioned above the gas burner 3. This oil burner is not ordinarily used but is provided for emergency firing in case of failure of the gas supply to the gas burner 3. The space above the gas burner 3 and below the lowermost part of the standard burner setting (indicated by the line 4—4, in Fig. 2) is filled in with fire brick or other refractory material to prevent the passage of any air into the combustion chamber other than that passing in through or between Venturi tubes 7.

Gas burners in which a gas discharge jet, or a plurality of jets, are positioned back of tubular mixing chambers of tile, are broadly old, being disclosed and claimed in my copending application Serial No. 214,570, filed August 22, 1927, and issued as Patent No. 1,889,993 on December 6th, 1932. The present invention has to do with a furnace construction employing tiles of novel shape and burners of special design to increase the efficiency and facilitate assembly, and having special means for regulating the gas and air supplied to the burner.

Thus, referring to Figs. 3 and 4, the mixing chamber positioned in front of each gas nozzle 9 is formed by a tile having a Venturi shaped passage therethrough. This Venturi shaped passage serves to facilitate the mixing of the gas with the air which is drawn in about the gas jet so that substantially complete combustion of the gas is obtained without the use of an excessive amount of air, which would tend to decrease the overall efficiency of the furnace by unnecessary dilution of the hot gases.

As shown in Figs. 7 to 10, each burner tile 6, although having a Venturi shaped passage therethrough, is of the same outside dimensions from end to end and is roughly octagonal in outside shape. When assembled, as shown in Fig. 7, all the tiles are in contact with each other and are mutually self-supporting. However, to prevent any accidental longitudinal displacement of any tube or tubes, and to brace the furnace in which the tiles are set, horizontal supporting rods 18 are provided between adjacent horizontal rows of tiles, each tile being provided with transverse grooves 19 in its top and bottom which engage with the rods 18. If desired, the rods 18 may be extended vertically between vertical rows of tile.

Since the grooves are substantially semi-cylindrical in shape, the rods 18 fit snugly therein and at the same time there is actual contact between the tiles in each row. A particular advantage of this form of construction is that tiles may be removed and replaced from the rear of the burner without dismantling the whole assembly. Likewise, they may be removed from the front or furnace side of the burner, if desired. In either case, the removal is accomplished by simply grasping the tile and twisting it one-eighth of a revolution, thereby disengaging the grooves 19 from rods 18 and withdrawing the tile. As shown to best advantage in Fig. 9, the outer face 20 of each tile is slightly rounded so that each tile can be twisted without displacing the surrounding tile to any appreciable extent. The surface 20, however, is sufficiently flat to retain the tile in position except when it is purposely twisted to remove it.

Although mixing tubes of the type described can be used with various types of gas nozzles, I prefer to use a nozzle of the type disclosed in Figs. 15 and 16 in which the gas is mixed with a certain amount of air before being discharged into the hollow tile.

Referring to Fig. 15, each burner nozzle 9 comprises a substantially cylindrical tip body 9a having a plurality of Venturi openings 81 extending therethrough. In the tip shown, three passages have been provided, but more may be used if it is desired to increase the capacity. Body 9a is mounted in front of a multi-jet nozzle 82 having a plurality of jets 83, each of which is positioned within the end of one of the Venturi tubes 81.

The body 9a is provided with a central opening 84 into which a centering projection 85 on nozzle 82 fits. Projection 85 serves to center the burner tip 9a with respect to nozzle member 82 and a shoulder shown at the base of projection 85 serves to space the burner tip from the base member to permit the entry of air into jet passage 81 around the associated jets 83. The member 9a may be secured to the base member 82 by means of a pin 86 passing through the member 9a and the projection 85.

As pointed out above, the discharge of gas from the burner jets 83 through the Venturi openings 81 and 7 causes the suction through the tubes,

along with the gas, of the air necessary for combustion. This air is drawn in through the space between the burner nozzles and the tiles, and the volume of air supplied is controlled in accordance with the present invention by a pair of doors 21.

Referring to Fig. 3, these doors are supported on hinges 22 at each side. In closed position, as shown in Fig. 3, the doors fit snugly against wall 23 so that there is no passage opening from the front of the furnace to the burners. Intake passages 25 are also provided in the floor of the burner compartment for supplying heated air thereto from a passage 24 (see Fig. 2) extending below the furnace, and passages 24a are provided in the top of the burner compartment for supplying heated air thereto from a passage 25a extending between the I-beams 25b; but these passages 25 and 24a are normally closed by horizontal plates 26 which are secured to doors 21. Hence when the doors 21 are in the position shown in Fig. 3, all air passages leading into the burner compartment are closed. When gas is admitted to the burners, doors 21 are automatically opened to admit air in proportion to the gas being delivered to the burners by the automatic valve 13, the construction and operation of which will now be described.

Referring to Fig. 4, the automatic valve comprises a diaphragm 27 of flexible material clamped between two bell-shaped casing members 28 and 29 and forming a gas-tight partition therebetween. Attached to the center of diaphragm 27 and extending therebelow, is a connecting member 30 having attached thereto a valve 31 which seats in a seat member 32. Attached to the upper side of diaphragm 27, and extending thereabove is a member 33 to which is connected, by a link 34, a lever 35. Lever 35 is pivoted to rotate about a pin 36 as a fulcrum and has hingedly attached thereto a link 37 which is pivotally connected at its other end to a collar 38 sliding on a rod 39 which projects from the framework 10 of the burner. A cross arm 40 is adjustably attached to collar 38 and is connected at its outer ends by links 41 to the doors 21. Hence it will be seen that raising diaphragm 27 rotates lever 35 about pivot 36, withdraws the collar 38 outwardly along the rod 39, thus shifting cross arm 40 outwardly and opening doors 21.

In operation, when no gas is admitted to supply pipe 11, diaphragm 27 is held in its lowermost position, as shown in Fig. 4, by a weight 42 on the lever 35, and doors 21 are held in closed position. When gas is admitted to supply pipe 11, it flows into the space below diaphragm 27 and if the pressure is sufficient lifts diaphragm 27, thus raising valve 31 from seat 32 and admitting gas to the burner nozzles 9, and simultaneously lifting member 33, link 34 and shifting lever 35 to withdraw collar 38 outwardly along rod 39 and open doors 21 to admit air to the burner. Since the end of the lever 35 on which weight 42 is mounted is tilted downwardly when diaphragm 27 is in its lowermost position, it is raised and approaches the horizontal position as the diaphragm rises. Hence weight 42 on lever 35 exerts a greater resisting force on lever 35 as the diaphragm 27 lifts. As a result, lever 35 and doors 21 connected therewith assume a position of equilibrium when the gas pressure beneath diaphragm 27 is just sufficient to overcome the downward force exerted by weight 42. If the gas pressure increases, the doors are opened further and if the gas pressure decreases, the doors are closed proportionately. Thus the air supply is automatically regulated

in proportion to the gas pressure applied to the burner.

It should be noted that the plates 26 are attached to doors 21 and open therewith, as shown in Fig. 5, to admit preheated air from passages 24 and 25a, through openings 25 and 24a. Thus a single moving element, that is, each door 21 and the plate 26 attached thereto, serves to control the admission of both preheated and cool air.

It is desirable, when gas is admitted to supply pipe 11, that the doors 21 open to admit air to the burners before gas is actually discharged from the nozzles 9. I therefore provide a lost motion device between diaphragm 27 and valve 31 that will permit the diaphragm to rise slightly and partly open the doors 21 before valve 31 lifts from its seat 32 and admits gas to the burners. I have developed various mechanisms for achieving this purpose, three of which are illustrated in Figs. 11, 12 and 13.

Referring to Fig. 11, the member 30, extending upwardly from valve 31, is attached to diaphragm 27 by a clamp member 44. Thus member 44 fits against the lower side of diaphragm 27 and is secured thereto by a threaded stud 45 (see Fig. 4), extending from the lowermost end of member 33, stud 45 screwing into member 44 and clamping the diaphragm 27 therebetween. Member 30, projecting upwardly from valve 31, has a vertical slot 46 in its uppermost end into which a tongue 47 extends from member 44. Tongue 47 also has a vertical slot 49 therein and a pin 48 passing through the upper end of member 30 engages the slot in tongue 47. Since the vertical dimension of slot 49 is greater than the diameter of pin 48, member 44 attached to diaphragm 27 can rise through a distance equal to the difference in the diameter of pin 48 and the length of slot 49 before it lifts member 30 and valve 31. In this embodiment, the valve 31 has a tapered face 50 which seats against a tapered face on the valve seat 32. To further delay the admission of any appreciable amount of gas until the diaphragm 27 has risen some distance, a downwardly projecting substantially cylindrical skirt 51 is provided on the valve 31. The effective length of the cylindrical portion extending below the valve seat 32 may be varied by raising or lowering the skirt portion 51 relative to the valve proper 31. Thus, as shown, skirt portion 51 is provided with a downwardly extending tubular extension 52 which is hollow and threaded on its inner circumference. Valve member 31 is provided with a downwardly extending stem 53 which is threaded exteriorly and is adapted to screw into the upper end of the tubular extension 52. The lower end of stem 53 is split into four segments, as shown in the cross sectional view of Fig. 14, so that by screwing a pointed pin 54 up into the lower end of tube 52, the lower end of the threaded stem 53 may be spread and locked firmly with respect to the tubular member 52. The lower ends of tubular members 52 and the locking pin 54 are squared to permit their being turned relative to each other by means of wrenches.

The valve just described provides adjustment of the degree of opening of doors 21 before the admittance of appreciable amounts of gas, by means of the adjustable skirt 51. In the valve shown in Fig. 12, adjustment is provided by regulating the degree of play in the lost motion connection between the valve 31 and the member 44 attached to diaphragm 27. In this arrangement, the valve 31 is provided with an inner member 55 which is movable vertically within a hollow stem

56 of the valve and projects from the top of a tubular extension 57 on the valve. Member 55 is provided at its top with a shoulder 58 which fits loosely in an opening 59 in the bottom of member 44 and is secured therein by a retaining nut 60 which is screwed onto the lower end of member 44. With this arrangement, when the diaphragm is in the lowermost position, retaining nut 60, attached to member 44, rests on the top of the tubular extension 57 on valve 31. When member 44 is lifted by diaphragm 27, it moves a certain distance before engaging the shoulder 58 on rod 55 and hence introduces the desired lost motion between the diaphragm 27 and valve 31. The amount of lost motion may be varied by screwing rod 55 in or out of the stem 56. A slot 61 is provided in the lower end of rod 55 to permit turning it with a screw-driver and a lock-nut 62 is provided to lock it into position when it has been properly set. It should be noted that since the lower end of rod 55 and lock-nut 62 projects below the sleeve 63 (referring to Fig. 4), it may be adjusted without disassembling the valve.

In Fig. 13 is illustrated still another form of valve incorporating a lost motion device. In this arrangement, the member 44 is secured, by a nut 63a, to a plunger 64 which extends entirely through the body of the valve 31. Surrounding plunger 64 and threaded thereon at the lower end is a bushing 65 slidably mounted within a tubular stem 66 extending downward from the skirt portion 67 of the valve. Skirt portion 67 is threaded onto the valve 31 and is locked into position by a detent 68 fitting into a depression in member 31. In operation, member 44, plunger 64, and sleeve 65 rise with the diaphragm 27, independently of the valve 31 until the upper end of sleeve 65 strikes a shoulder 69 on valve 31 and lifts the valve from its seat. In this type of valve the amount of lost motion is controlled by turning sleeve 65 and thus screwing it in or out with respect to plunger 64. Thus if sleeve 65 is screwed out it must rise a greater distance before contacting with shoulder 69. When set at the proper point, it is locked in position by a lock-nut 70.

It sometimes happens that the flexible diaphragm 27 becomes leaky, under which condition there is objectionable leakage of gas into the atmosphere and the automatic mechanism may not function to open the draft door 21. I therefore provide means for altering the automatic valve so that in case of necessity the draft door can be operated by manual control. Thus, referring to Fig. 4, a cap 71 is provided on the lower end of the valve housing 63, and a stud 72 is threaded into the cap. By screwing stud 72 into cap 71 the valve 31 and diaphragm 27 may be forced upward until a shoulder 73, having a ground, beveled edge, seats against a ground, beveled seat 74, formed in the upper case member 28 of the diaphragm chamber. In this position the valve 31 is open to permit gas to flow from the supply pipe 11 to the burner through pipe 43, and the opening about the stem 33 is sealed by shoulder 73 to prevent the leakage of gas at that point. The link 37 may then be disconnected from the sleeve 38 and the draft regulated by manually sliding the sleeve 38 along rod 39 to give any desired opening of the doors 21.

It is to be understood that under all conditions of operation the supply of gas to the burners is controlled by a valve inserted at some point between the gas pipe 11 and the source of supply. Thus referring to Fig. 1, gas is supplied to the pipe 11 associated with each burner from

a main 114 through a pipe 12, an emergency valve 111 and a control valve 110. In normal operation the valve 111 is wide open and valve 110 is adjusted to control the heat by admitting more or less gas to the pipe 11.

In automatic operation, the draft door opening obtained in response to a given movement of diaphragm 27 may be regulated by connecting the link 37 to different points along lever 35, and to facilitate such adjustment lever 35 is curved and slotted as shown in Fig. 4.

As shown in Fig. 7, each burner usually comprises about eighteen jets, although the number may be varied, depending upon the size of the furnace opening, and I find it convenient to utilize one of the center jets in the lower bank as a pilot burner and supply it from a separate gas line 75 (Fig. 3). It is also desirable to supply another jet, preferably one adjacent the pilot jet, by a separate passage 76 leading from supply line 11 ahead of valve 13. This is advantageous for the following reasons: When the furnace is being operated at a low capacity, the gas supplied to pipe 11 may be almost cut off, so that although there is sufficient pressure to lift the diaphragm 27 and open valve 31, the gas flowing from each nozzle 9 may have so little velocity that it does not draw in sufficient air for its proper combustion, or it may not ignite at all. Thus there is wastage of gas. By providing the by-pass 76 from supply pipe 11 to one only of nozzles 9, any slow flow of gas through pipe 11 passes directly through by-pass 76 and can not build up enough pressure against diaphragm 27 to open valve 31. The net result is that when the supply of gas to line 11 is almost, but not quite cut off, what gas does enter the burner is burned efficiently at one burner instead of wasting at low pressure from all the burners.

The pilot and auxiliary burners are provided with larger flanges than the other burners, as shown in Figs. 3 and 4. This is to reduce the amount of air drawn into the Venturi tubes of those burners, and reduce the possibility of the flames from those burners being blown out.

It is to be noted that when doors 21 are only partly open they admit air directly to the center of the burner. This is desirable because it is found difficult in practice to supply sufficient air to the central part of the burner, without supplying an excess of air to the outer edges.

What I claim is:—

1. In a furnace construction, a combustion chamber, means for supplying gaseous fuel thereto comprising a supply line, a valve in said supply line, a movable diaphragm, one side of which is exposed to the pressure of gas in said supply line ahead of said valve, a connection between said diaphragm and said valve whereby motion of said diaphragm in response to gas pressure exerted thereon opens said valve, means defining a passage for admitting air to said combustion chamber, a door in said passage, and means connecting

said door to said diaphragm for opening said door in response to gas pressure in said line.

2. In a furnace construction, a combustion chamber, means for supplying gaseous fuel thereto comprising a gas line, a valve in said gas line, means for supplying air to said combustion chamber comprising a passage having a door therein, a movable diaphragm, one side of which is exposed to the pressure of gas in said supply line ahead of said valve, means connecting said diaphragm and said door for opening said door in response to gas pressure on said diaphragm, and means connecting said diaphragm to said valve comprising a lost motion connection for opening said valve subsequent to the opening of said door.

3. In a furnace construction, a combustion chamber, a plurality of burners for supplying a mixture of gaseous fuel and air to said combustion chamber, a supply line for supplying gaseous fuel to said burners, a control valve in said supply line, a second valve in said supply line positioned between said control valve and said burners, a movable diaphragm one side of which is exposed to the pressure of gas in said supply line between said control valve and said second valve, a connection between said diaphragm and said second valve whereby motion of said diaphragm in response to gas pressure exerted thereon opens said second valve, means defining a passage for admitting air to said combustion chamber, a door in said passage, means connecting said door to said diaphragm for opening said door in response to gas pressure in said line between said control valve and said second valve, an auxiliary heating burner for supplying a mixture of gaseous fuel and air to said combustion chamber when only a small fire is to be maintained, and a by-pass gas line for supplying gas from said first gas line at a point between said control valve and said second valve to said auxiliary burner, whereby all gas supplied by said gas line is delivered to said auxiliary burner when the gas pressure in said line between said control valve and said second valve is insufficient to open said second valve.

4. In a furnace construction, a combustion chamber, a plurality of heating burners for supplying gaseous fuel to said combustion chamber, means comprising a gas line for supplying gas to some of said burners, a control valve in said gas line, and a second valve in said gas line between said control valve and said burners, means comprising a diaphragm one side of which is at all times exposed to gas pressure in said line between said control valve and said second valve for opening said second valve, and a by-pass gas line for supplying gas from said gas line at a point between said control valve and said second valve to another of said heating burners whereby all gas supplied by said gas line through said control valve is delivered to said other burner when the gas pressure in said line ahead of said second valve is insufficient to open said second valve.

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