

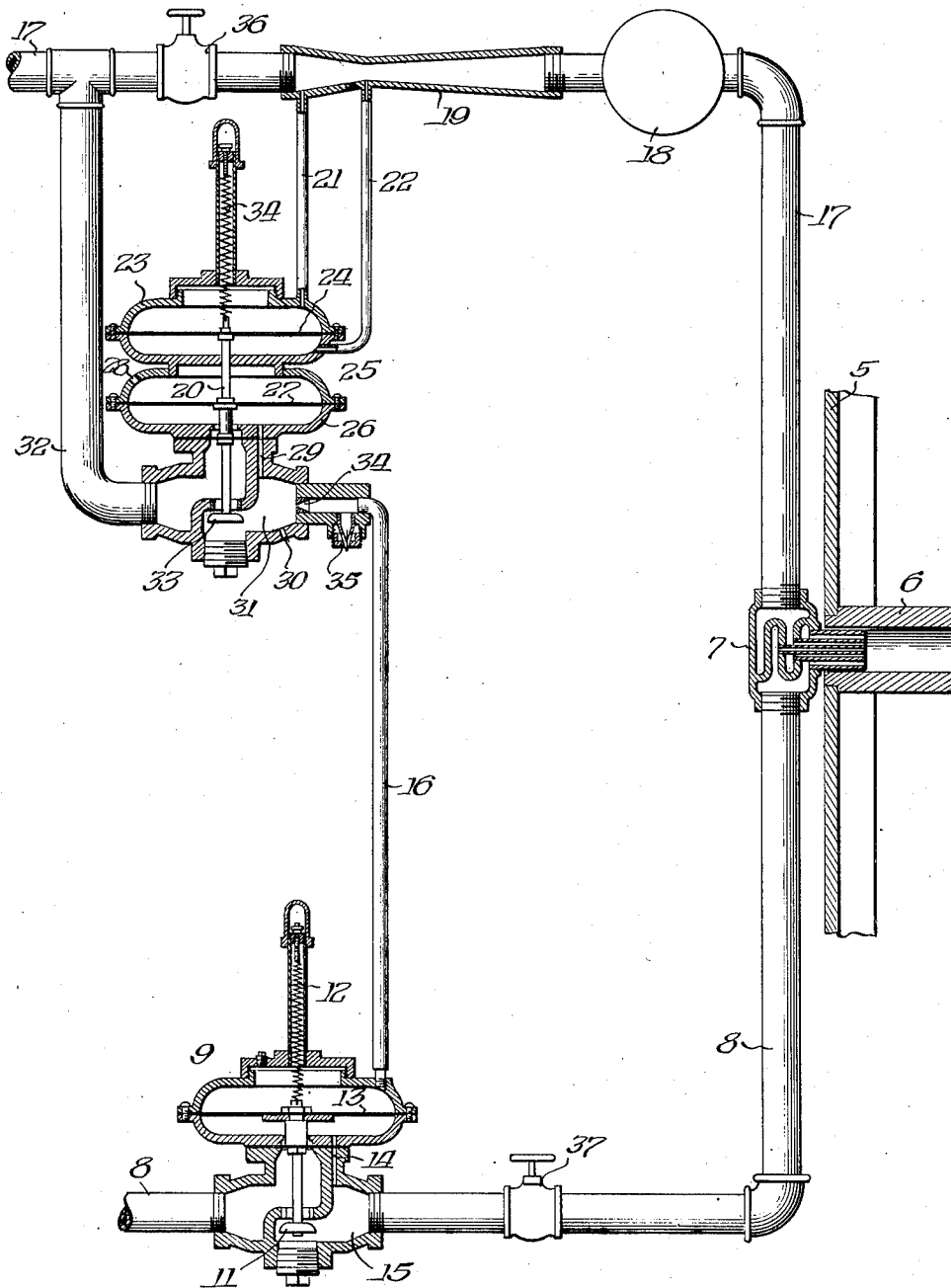
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APPARATUS FOR PROPORTIONATELY MIXING AIR AND GAS

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Witness:

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APPARATUS FOR PROPORTIONATELY MIXING AIR AND GAS.

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To all whom it may concern:

Be it known that I, GARNET W. McKEE, a citizen of the Dominion of Canada, residing at Rockford, in the county of Winnebago and State of Illinois, have invented certain new and useful Improvements in Apparatus for Proportionately Mixing Air and Gas, of which the following is a specification.

This invention relates in general to apparatus for mixing air and gas and pertains more specifically to apparatus of this character adapted to deliver air and gas in predetermined proportions irrespective of variations in the air flow induced by a variable resistance in the air line or by other causes.

In gas fired furnaces and other apparatus of similar character it is frequently desirable for purposes of economy and efficiency to pass the air constituent of the combustible mixture delivered to the burners, through a recuperator or other apparatus by which heat units from the exhaust gas of the furnace are transferred to the inflowing air. Since the inflowing air passing through the recuperator is expanded to a greater or less degree, depending upon the temperature of the exhaust gases from the furnace, it follows that the recuperator acts as a variable resistance to the flow of air through the air line.

The primary purpose of my present invention is to provide a proportional mixing apparatus which will deliver a mixture of air and gas of proper proportions irrespective of fluctuations in the pressure of the air and gas constituents and irrespective of variations in the resistance imposed upon the air line beyond the control point.

Another object is the provision of an apparatus of the character indicated which will be very sensitive to flow variations in the air line, one which will be thoroughly reliable in operation, and one in which the volume of mixture may be controlled by the manipulation of a single valve in the air line.

Another object is to provide an apparatus which will be readily capable of adjustment so as to vary the relative proportions of air and gas delivered in order to produce a combustible mixture of the requisite proportions.

My invention further contemplates a novel method by which the desirable character-

istics above mentioned, and others, may be secured.

Other objects and advantages of my invention should be readily appreciated as the same becomes better understood by reference to the following description, when considered in connection with the accompanying drawing.

On the drawing,—

The single figure is a somewhat diagrammatic side elevation, partially in section, of an apparatus constructed in accordance with my invention.

Referring to the drawing more in detail, reference character 5 indicates generally a fragment of the side wall of a furnace or other heating apparatus into which the delivery nipple 6 of a mixing burner indicated generally by 7 projects. While this mixing burner may be of any preferred construction, it is illustrated as being of the type wherein the air and gas enter the burner casing from opposite sides and are delivered into the nipple in a series of concentric rings or cylinders of different diameters, the rings of air alternating with the rings of gas as is common in this type of burner.

Gas is supplied to the burner through a gas supply pipe 8 in which is interposed a control device indicated generally by 9 and commercially known as a zero regulator. The regulator comprises a balanced valve 11 suspended from an adjustable spring 12 and connected with a diaphragm 13, the lower face of which communicates through a port 14 with the delivery chamber 15 of the casing and the upper face of which is subjected to air pressure entering through an intermediate pipe 16 and controlled as will be later explained.

Air is supplied under pressure to the burner through an air supply pipe 17 in which is interposed a recuperator 18 or other apparatus adapted to produce a variable resistance in the air line. Since the recuperator or other apparatus may be of any well known or preferred type, the details of construction thereof are not illustrated herein but the apparatus is diagrammatically illustrated only.

The point in the air line to which the gas control is connected is located forwardly of the recuperator, that is, between the recuperator and the fan blower or other ap-

paratus employed for delivering air through the line under pressure.

Since the flow of air through the air line will vary in accordance with variations in the resistance imposed upon the line by the recuperator, my present invention contemplates the utilization of this variation in flow to control the delivery of gas to the burner in accordance with these air flow variations. With this end in view I have interposed in the air line a Venturi tube 19 and have connected a pipe 21 to said tube near its intake end and a pipe 22 to the throat of the tube. Since the volume of air flowing through the tube is a square root function of the difference in pressures exerted on the pipes 21 and 22 from the tube, it will be manifest that through these pipe connections with the tube I obtain a pressure differential which may be utilized for controlling the gas.

The pipes 21 and 22 are connected to a diaphragm chamber 23 respectively above and below a diaphragm 24 disposed therein. This chamber and diaphragm are part of a control unit indicated generally by 25, comprising also a second diaphragm chamber 26 in which a diaphragm 27 is mounted, the chamber above the diaphragm being open to atmosphere through a port 28 and the chamber below the diaphragm communicating through a port 29 with the delivery chamber 31 of a casing to which the air line 17 is connected through a branch 32. A balanced valve 33 suspended from an adjustable spring 34 and connected with the diaphragms 24 and 27 regulates the air pressure entering the chamber 31. Since the pressures exerted through the pipes 21 and 22 upon the upper and lower faces of the diaphragm 24 vary in conformity with variations in air flow through the venturi 19 the valve 33 connected to the diaphragm by the rod 20 will be correspondingly opened or closed, thus varying the air pressure in the chamber 31 in accordance with variations in the air flow through the main air line. To insure accurate results an opening 30 from chamber 31 to atmosphere is provided which causes valve 33 to remain slightly off its seat.

The air pressure delivered through the main control unit is utilized to regulate the gas controller 9 and pipe 16 is, therefore, connected with the delivery chamber 31 of the main controller unit. In order to preclude the delivery of an excessive air pressure through the pipe 16 a restriction 34 is interposed in the connection between the pipe 16 and the chamber 31. Furthermore, in order to variably reduce the pressure transmitted to the controller 9 so that the movements of the valve 11 in the gas line, which is under a much lower pressure than the air line, will be slight and subject to

delicate control, I have interposed in the connection between the controller 9 and the chamber 31 of the main controller an adjustable delivery orifice 35 through which communication between the interior of the pipe 16 and atmosphere is established. This orifice may be manually regulated to permit the escape of any desired proportion of the air pressure delivered to the connecting pipe 16. Consequently by regulating this orifice any desired fraction of the air pressure delivered by the main controller may be utilized to operate the gas controller.

The maximum quantity of air delivered through the air line 17 may be regulated and controlled by manipulation of a hand regulating valve 36 or other preferred means of control. The ratio of gas delivered in proportion to this maximum of air may be regulated by the hand valve 37 in the gas line 8. When the desired ratio has been established by adjustment of the valve 37 this ratio will be always maintained irrespective of variations in the air flow by the apparatus described.

My invention operates according to the following principles. The resistance of the valve 37 and any resistance to gas flow set up by the burner 7 and the pipe line 8 connecting 37 and 7 may be considered as one and the same resistance and this composite resistance can be varied by manipulating the valve 37.

Now the amount of gas flowing from 15 to the furnace varies as the square root of the difference in pressure between point 15 and the pressure in the furnace. Since the pressure in the furnace is very low—substantially atmospheric pressure—the quantity of gas flowing to the furnace varies as the square root of the pressure at 15. Likewise the flow of air through the venturi will be a corresponding function of the difference in pressure between the intake end and the throat of the venturi. This pressure difference is transmitted through the pipes 21 and 22 to the diaphragm 24 which controls the valve 33 so that the pressure in the chamber 31 becomes also a function of the quantity of air flowing through the venturi. This pressure or such fraction thereof as may be determined by the adjustable orifice 35 is transmitted to the gas controller 9 with the result that the pressure of the gas at the outlet of the controller is likewise a function of the volume of air flowing through the venturi. The pressure on the inlet side of valve 37 varies, therefore, in accordance with variations in the quantity of air flowing through the venturi, consequently the quantity of gas delivered past this valve will always bear a simple ratio to the quantity of air delivered and this ratio may be varied by adjusting the valve 37. The predetermined proportions of air

and gas in the mixture will, therefore, always be maintained irrespective of variations in the quantity of air delivered.

The structural details illustrated and described may obviously be varied within considerable limits without departing from the essence of the invention as defined in the following claims.

I claim:

1. In an apparatus for proportionately mixing air and gas, an air supply line, means for producing a pressure differential in said air line, an intermediate pipe, means for varying the fluid pressure in said pipe in accordance with said differential, a gas supply line, and means for varying the flow of gas in said gas supply line in accordance with the pressure in said pipe.

2. In an apparatus for proportionately mixing air and gas, an air supply line, means for producing a pressure differential in said air line, an intermediate pipe, adjustable means for varying the pressure in said pipe in accordance with said differential, a gas supply line, and adjustable means for varying the flow of gas in said gas supply line in accordance with the pressure in said pipe.

3. In an apparatus for proportionately mixing air and gas, an air supply line, means for producing a pressure differential in said air line, an intermediate pipe, adjustable means for varying the pressure in said pipe in accordance with said differential, a gas supply line, adjustable means for varying the flow of gas in the gas supply line in accordance with the pressure in said pipe, and adjustable means for stopping the flow of gas in said gas supply line when the pressure differential in the air line decreases below a predetermined value.

4. In an apparatus for proportionately mixing air and gas, the combination of an air supply line, a gas supply line, a controller in said gas supply line, means in said air supply line for producing a pressure differential adapted to fluctuate in accordance with fluctuations with the flow in said line, a branch line connecting said air supply line with said gas controller, and means controlled through said pressure differential for regulating said gas controller through the intermediary of the air in said branch line.

5. In an apparatus for proportionately mixing air and gas, the combination of an air supply line, a gas supply line, a gas controller in said gas supply line, a connecting pipe between said air supply line and said controller, and means controlled by the flow of air in said air supply line for regulating said gas controller through the intermediary of the air in said connecting pipe to thereby regulate the flow of gas in said gas supply

line in accordance with variations of flow in the air supply line.

6. In an apparatus for proportionately mixing air and gas, the combination of an air supply line, a gas supply line, a controller in said gas supply line, a connection between the air supply line and the controller, a regulating valve in said connection, means in the air supply line for producing a pressure differential in accordance with variations in the flow through said line, and means actuated by said pressure differential for controlling said regulating valve.

7. In an apparatus for proportionately mixing air and gas, the combination of an air supply line, a gas supply line, a gas flow controller in said line, said controller including a diaphragm controlled valve, an air connecting pipe between said air line and said diaphragm, a regulating valve in said air connecting pipe, a Venturi tube in said air supply line, a diaphragm connected with said regulating valve, and means for establishing communication between opposite faces of said diaphragm and the intake end and the throat, respectively, of said Venturi tube.

8. In an apparatus for proportionately mixing air and gas, the combination of an air supply line, a gas supply line, a gas flow controller in said gas supply line, comprising a diaphragm controlled valve, a pipe establishing communication between the air supply line and one face of the diaphragm of said controller, a regulating valve in said pipe, the diaphragm controlling said valve, a Venturi tube in the air supply line, a pipe connecting an end of said tube with one face of said diaphragm, a pipe connecting the throat of said tube with the other face of the diaphragm, and a variable resistance device interposed in the air supply line at the delivery side of said Venturi tube.

9. In an apparatus for proportionately mixing air and gas, the combination of an air supply line, a gas supply line, a gas flow controller comprising a diaphragm controlled valve in the gas supply line, a recuperator in the air supply line, a Venturi tube in the air supply line ahead of the recuperator, a pipe connecting the air supply line with said gas controller, a primary controller comprising a double diaphragm controlled valve interposed in said pipe, an adjustable orifice in the pipe between the said controllers, means for establishing communication between one end of the venturi and one face of the diaphragm with the primary controller and means for establishing communication between the throat of said venturi and the other face of said diaphragm.

GARNET W. McKEE.