

Feb. 8, 1966

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3,233,987

GAS MIXING

Filed Aug. 21, 1963

FIG. 2

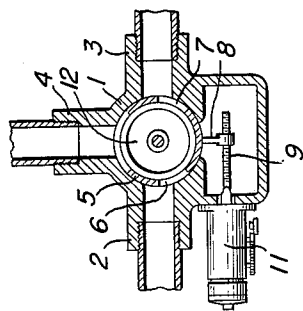
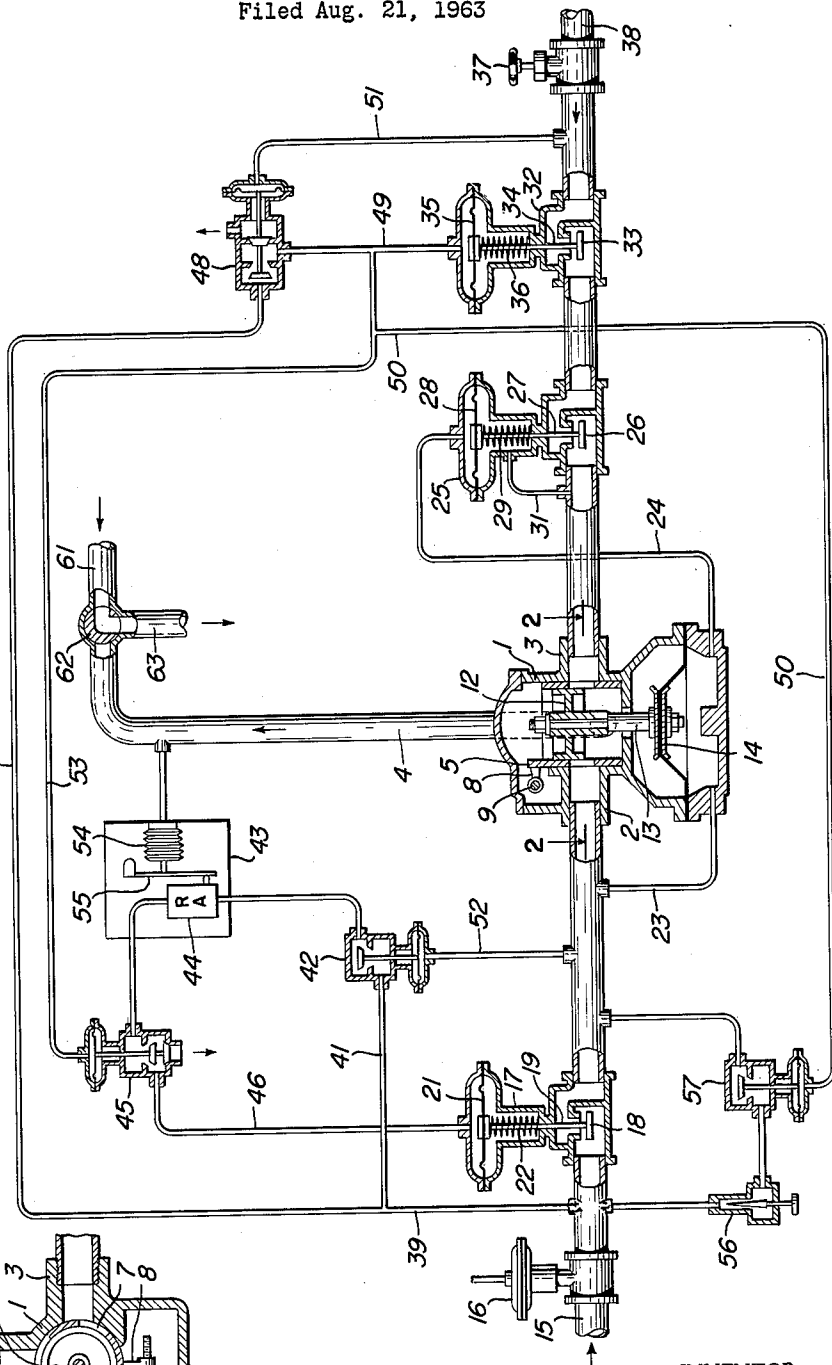


FIG. 1



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3,233,987

GAS MIXING

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Filed Aug. 21, 1963, Ser. No. 303,573

2 Claims. (Cl. 48—180)

The present invention relates to the mixing of a plurality of gases, such as the mixing of air and LP gas as a substitute for natural gas.

In many communities that are supplied with natural gas, the supply is not sufficient to take care of peak loads, or is interruptible. This is particularly true with respect to industries that use natural gas as a fuel. In such cases it is usual to have a standby fuel, such as propane, available when the gas supply is insufficient or cut off. Since the B.t.u. per cubic foot of propane is higher than that of natural gas, it is necessary to mix the propane with air to match substantially the heat content and burning characteristics of natural gas prior to supplying it to the gas mains.

It is an object of the present invention to provide a method and apparatus for mixing a plurality of gases. It is a further object of the invention to provide a system for mixing a plurality of gases in which safety features are provided to insure that, upon failure of pressure of either of the gases being mixed, the gases will be cut off.

The present invention will be described as being used for the mixing of propane and air. It will be apparent, however, that the system is equally as applicable for the mixing of any other gases.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, its advantages and specific objects attained with its use, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described a preferred embodiment of the invention.

In the drawings:

FIG. 1 is a diagrammatic view of the apparatus making up the system of the invention; and

FIG. 2 is a sectional view taken on line 2—2 of FIG. 1.

Referring to FIG. 1, there is disclosed a gas mixing machine 1 having an air inlet 2, a gas inlet 3 and a mixture outlet 4 through which the mixture is discharged to some point of use. The mixing machine includes a cylindrical sleeve 5 which is provided with an air port 6 and a gas port 7, with the sleeve being rotated relative to the two inlets so that they are varied in size, thereby permitting the air and gas in various amounts to be introduced into the machine. This sleeve is provided with an adjusting arm 8 from which an adjusting rod 9 extends to the exterior of the machine so that it can be adjusted by a mechanism 11 to rotate the sleeve for obtaining the proper ratio of the mixture. The amount of mixture is varied by a piston 12, the lower end of which blocks the air and gas ports in amounts depending upon its height. This piston is mounted upon a rod 13, the lower end of which is attached to a diaphragm 14.

The main air supply to be used for the mixture can come from any suitable source such as a pump or a plant air supply through a pipe 15. Since it is desirable to have this supply at a substantially constant pressure, a pressure regulator 16 is shown as being inserted in the line. The air passes through a pneumatically operated, normally closed valve 17. This valve is provided with a valve plug 18 that is connected with a rod 19 to a diaphragm 21. The diaphragm and rod are normally biased in an upwardly direction to close the valve by means of

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a spring 22. Air passing through the valve goes directly to inlet 2 of the mixing machine.

Air pressure is applied through a connection 23 to a chamber beneath the diaphragm 14 of the mixing machine and through a pipe 24 in a zero governor or pressure regulator 25 that is placed in the gas line 3. This regulator operates to reduce the pressure of the gas so that it is equal to that of the air at their respective inlets to mixing device 1. To this end, the regulator is provided with a plug 26 that is mounted on a stem 27, the upper end of which is attached to a diaphragm 28. This diaphragm divides the regulator into an upper chamber to which the air pressure is applied, and a lower chamber which is connected by a passage 31 with the downstream side of the regulator. It is noted that there is provided a spring 29, normally tending to close the regulator. This spring has sufficient force to support the weight of the movable parts and to take care of any slight differential pressure which may be desired between the air and the gas.

Upstream of the regulator there is provided a pneumatically operated automatic cut off valve 32 which is used to shut off the supply of gas if there should be a failure of the gas pressure for any reason. This shut off valve includes a valve plug 33 that is attached by a stem 34 to a diaphragm 35. The valve is normally biased in the direction to close the valve by means of a spring 36. Gas is supplied through a manually operated valve 37 to the automatic valve from a suitable source of gas supply, such as a propane vaporizer, indicated at 38.

The air pressure required to operate valves 17 and 32 can be obtained from any convenient regulated source, which is shown herein as being the main supply of air. To this end the air for operating valve 17 passes through tubes 39 and 41 to a valve 42 that is opened or closed in response to air pressure at the inlet of the mixing device. The air is then regulated by a standard pneumatic controller 43 having a reverse acting relay 44 in it. The output of the relay is applied through a three-way valve 45 and tube 46 to the chamber above diaphragm 21 of valve 17.

Air pressure to operate valve 32 is applied through tube 47 to a three-way valve 48, and tube 49 to the chamber above diaphragm 35. Valve 48 has a normal position to connect line 49 to the atmosphere so that valve 32 will be closed by spring 36. When valve 37 is open, and there is sufficient pressure in the gas line, the gas pressure will be applied through tube 51 to the diaphragm of valve 48 to adjust this valve to connect tubes 47 and 49, as shown. Valve 48 can be adjusted to operate at any predetermined pressure.

Valve 17 remains closed if there is no gas pressure and until there is enough air pressure in the system to start operation, as explained below. To this end valve 42, in tube 41, is closed until there is pressure in inlet pipe 2, when it is opened by application of pressure through tube 52. Valve 45 is normally biased to vent tube 46 to the atmosphere, but is moved to connect 46 with controller 43 when pressure is applied through a tube 53 from valve 48 and line 47, when there is gas pressure, as explained above.

When the system is operating, the amount of air and gas supplied to the mixing device depends upon the pressure of the mixture in outlet pipe 4. This is accomplished by having an expansible element 54 in controller 43, that is connected to pipe 4, operate pilot valve 44 through a spring biased lever 55. The arrangement is such that upon a decrease in mixture pressure, the output from 44 will be increased to open valve 17 and vice versa.

The system will begin operating automatically, assuming that air and gas under pressure are available, when gas

at the required minimum pressure is introduced into tube 51. Initially air is supplied to inlet 2 through a by-pass around valve 17 including a needle valve 56 and a pressure operated valve 57 that is opened by application of air pressure through tube 50 from valve 48. Valve 57 can be replaced by a manually operated valve if desired.

In many cases where two gases are being mixed it makes no difference which gas is first supplied to the mixing device. When the system is being used to mix air and LP gas, such as propane, as a stand-by fuel, however, it is desirable, if not essential, that air not be admitted to the mixture line until fuel is available for mixing with it. The present system has this feature. Conversely, the system will shut down automatically upon reduction of the propane pressure below the preset minimum.

In the operation of the system, gas under pressure is first admitted through valve 37. When the gas pressure, as sensed through line 51, has built up sufficiently it will shift valve 48 to the position shown. This will permit pressure to be applied from the main air supply through tube 47 and valve 48 and the tubes leading from it simultaneously to open gas valve 32, shift valve 57 to the position shown to permit air to flow into inlet pipe 2 through the by-pass at a rate determined by the setting of needle valve 56, and shift valve 45 to the position shown so that valve 17 can be operated by the output of controller 43. The action of valve 45, however, has no immediate effect since operating pressure to instrument 43 is still cut off by valve 42.

Needle valve 56 permits the pressure in inlet 3 to increase slowly enough so that the diaphragm 14 in mixing device 1 will not be injured. This same pressure is applied through line 24 to the top of diaphragm 28 of regulator 25. This gradually opens regulator 25 so that the gas pressure in inlet 3 of the mixing device matches the air pressure in inlet 2. Thus, as soon as air is admitted to inlet 2 of the mixing device, gas is admitted to inlet 3.

When air pressure in inlet 2 has increased sufficiently, valve 42 will open to admit control air to instrument 43. Since the mixture pressure in outlet 4 is low, the output on control pressure from instrument 43 will be high, thus opening air valve 17. Air and gas will then flow into the system and be mixed in volumes sufficient to supply the mixture at pressures determined by the setting of instrument 43.

Normally speaking a system of the present type is used for stand-by or peak shaving purposes in utilities or industrial plants. In such a case, the normal supply of fuel gas, such as natural gas, comes from pipe 61 through three-way valve 62, to supply main 63. When the supply of fuel gas is cut off it is only necessary to adjust valve 62 to connect pipe 4 with main 63. The mixture, which is pre-adjusted to match the burning characteristics and pressure of the regular fuel, immediately flows into main 63 to give an uninterrupted fuel supply. The mixture is available under pressure at all times.

From the above description it will be seen that the mixture pressure controls the supply of air and the air controls the supply of gas. The mixture pressure will be determined by the setting of controller 43, which setting can be adjusted in all commercially available controllers. Since the gas pressure on valve 48 controls the application of control pressure to valve 17, no air can be introduced into the system until gas is available. In addition, if the gas pressure falls below its preset value, valve 48 will be adjusted to vent control pressure lines 49, 50 and

53, thereby simultaneously permitting valves 17, 32 and 57 to close so that the system will shut down until gas under pressure is again available. Similarly, failure of air pressure will, in effect, vent lines 49, 50 and 53 through valve 48, thus permitting valves 32, 57 and 17 to close as they did upon failure of gas pressure.

The present system is adapted to be used for either high pressure or low pressure. The only changes that are necessary are the use of instruments and valves that are capable of withstanding the pressure that is required. It will be recognized that the basic system for mixing any two gases that has been disclosed can be modified to include other features that may be desired for particular installations. One such feature, for example, could be a conventional constant back-pressure valve on the mixture outlet line, or the automatic operation of valve 62 when the mixture is to be supplied to the gas main. The system is completely pneumatic in operation and the power required to operate it is obtained from the pressures of the gases being mixed.

From the above description it will be seen that I have provided a system for mixing any two gases that is automatic in operation, and that is provided with features which will cause it to shut down upon the failure of the supply of either gas.

While in accordance with the provisions of the statutes I have illustrated and described the best form of embodiment of my invention now known to me, it will be apparent to those skilled in the art that changes may be made in the form of the apparatus disclosed without departing from the spirit and scope of the invention set forth in the appended claims, and that in some cases certain features of my invention may be used to advantage without a corresponding use of other features.

What is claimed is:

1. Apparatus for mixing gases comprising a gas mixing device, means to supply a first gas to said device under gradually increasing pressure to a fixed predetermined pressure, means to supply a second gas under pressure to said device, means to adjust the pressure of the second gas substantially to equal that of the first gas as said first gas is increasing in pressure to said predetermined pressure, means to withdraw mixed gases from said device, a control instrument responsive to the pressure of the mixed gases, and valve means to control the supply of said first gas to said device and means to operate said valve means by said control instrument.

2. The combination of claim 1 including means responsive to the inlet pressure of the second gas, and means operated by said responsive means in response to loss of pressure of said second gas to shut off the supply of said first gas and said second gas to said device.

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MORRIS O. WOLK, *Primary Examiner*.