Dec. 7, 1965 R. P. NEWTON, JR 3,221,757

METHOD AND APPARATUS FOR MIXING GASES

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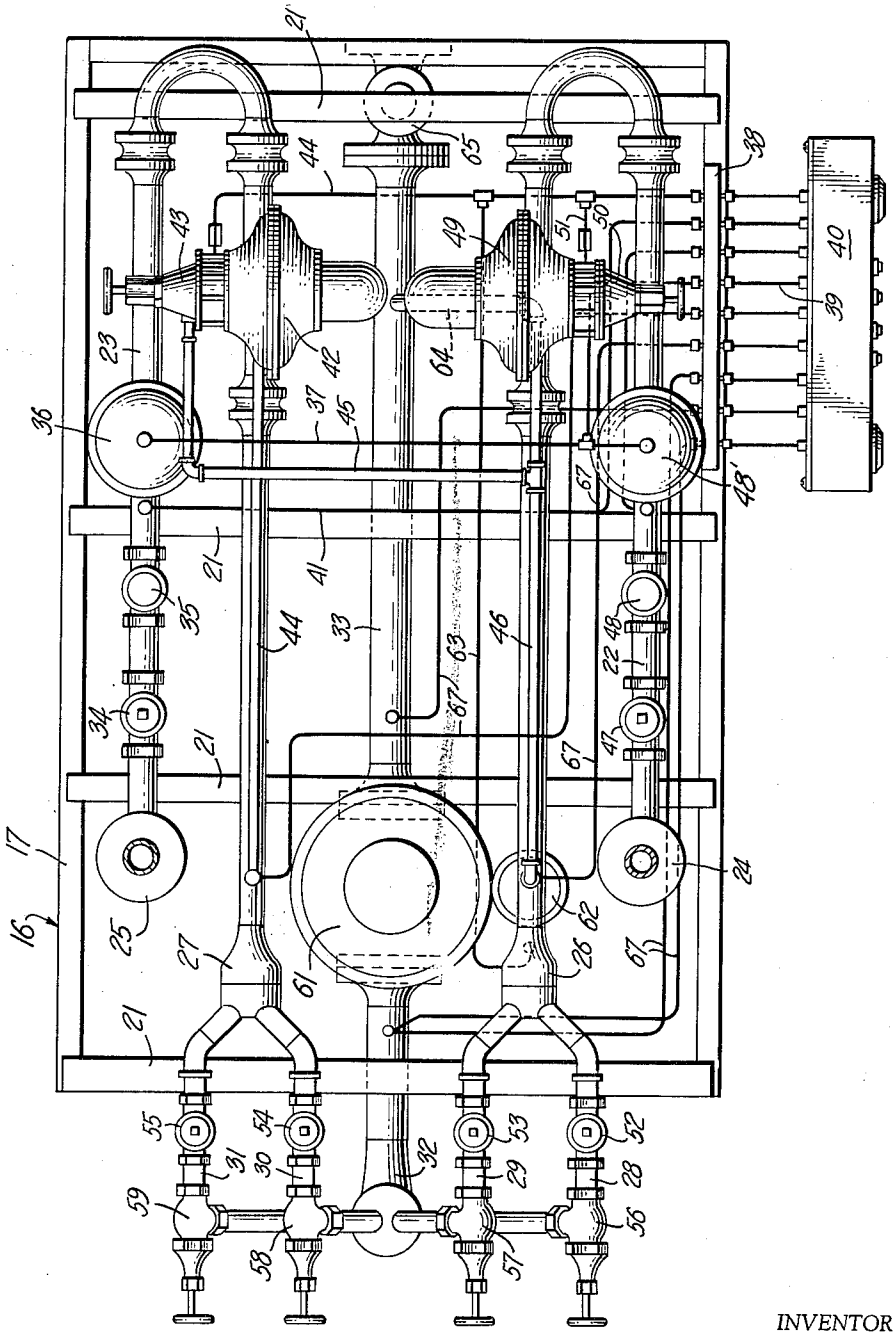


Fig. 1.

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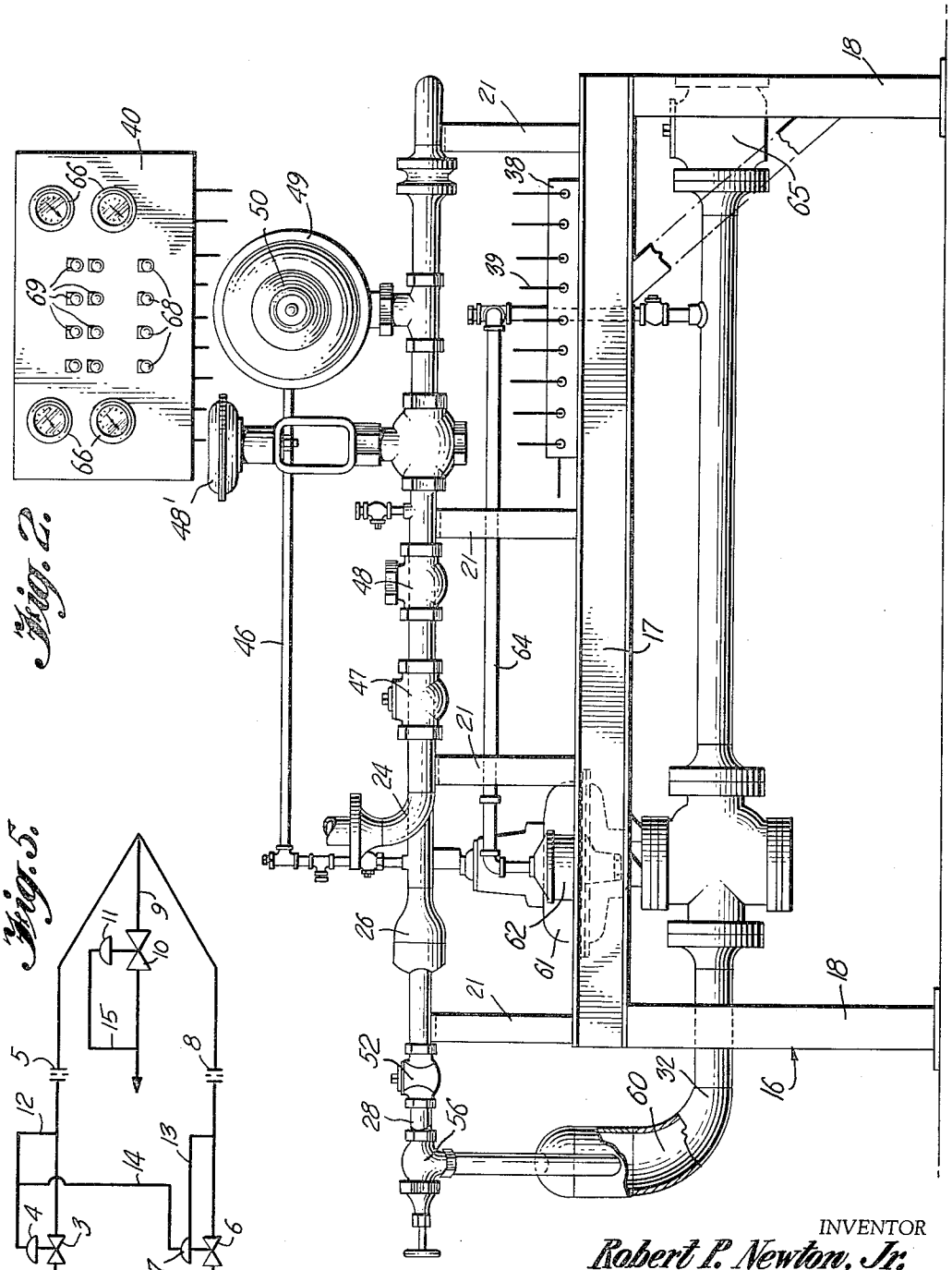


Fig. 2.

Fig. 3.

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METHOD AND APPARATUS FOR MIXING GASES

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Fig. 3.

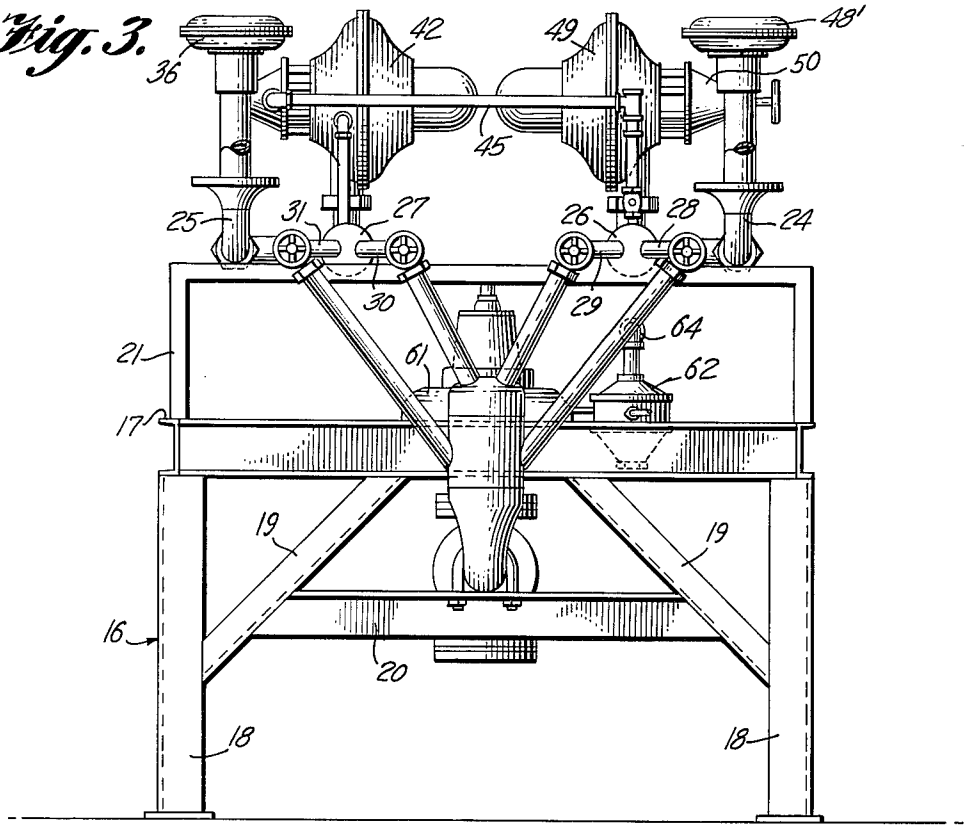
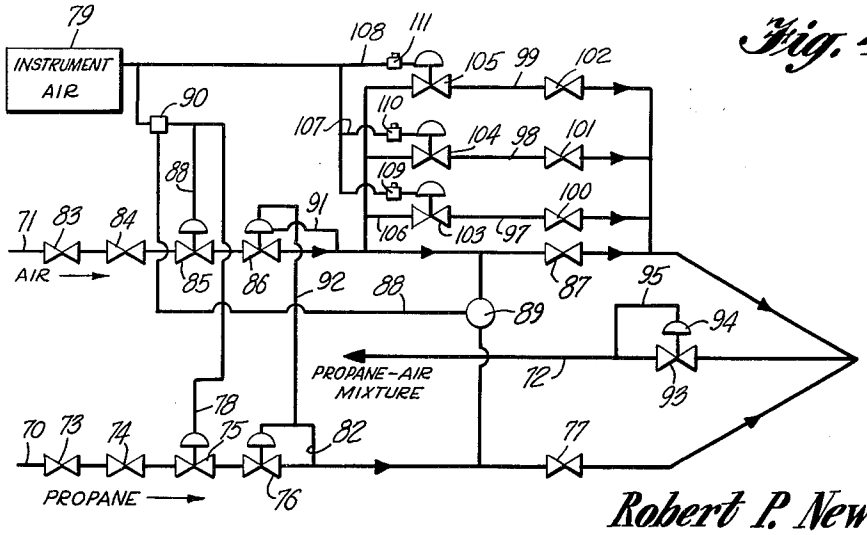


Fig. 4.



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METHOD AND APPARATUS FOR MIXING GASES

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Fig. 6.

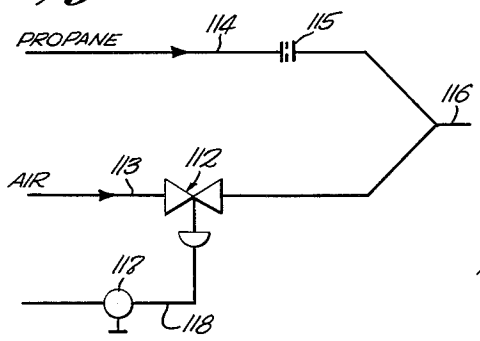


Fig. 7.

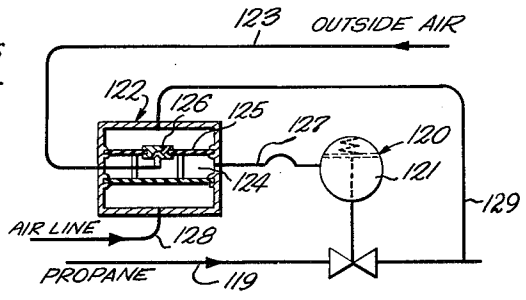


Fig. 8.

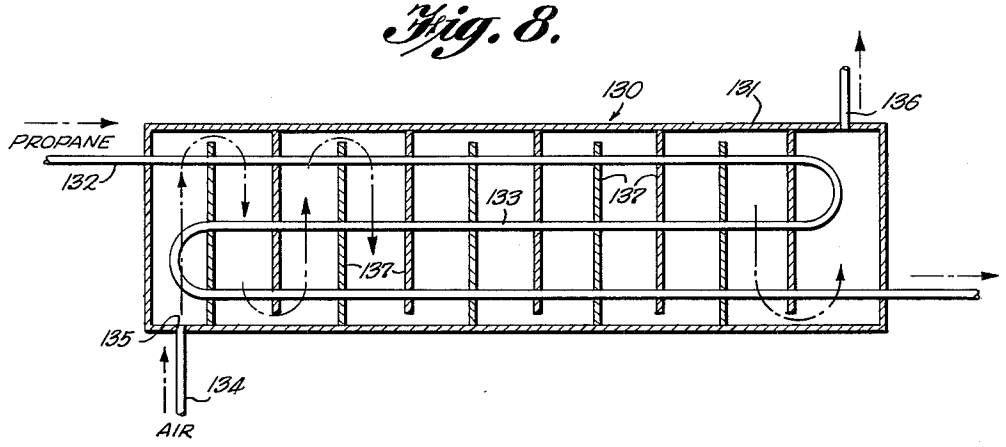
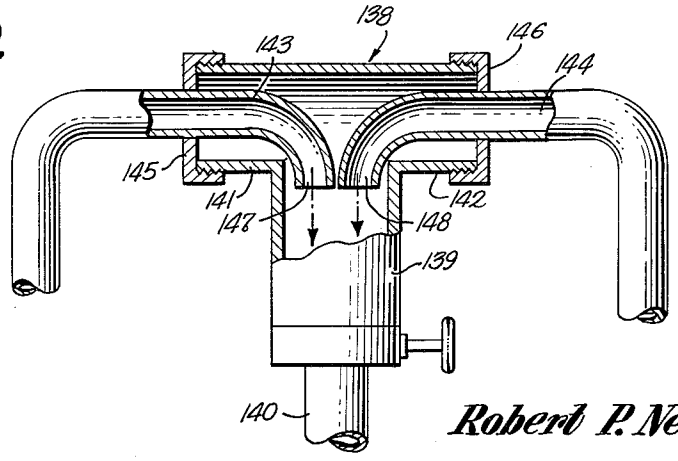


Fig. 9.



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METHOD AND APPARATUS FOR MIXING GASES

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Filed Mar. 29, 1963, Ser. No. 269,124
9 Claims. (Cl. 137—9)

This invention relates to gas mixing apparatus, and particularly to such apparatus adapted for mixing two or more gases in predetermined proportions and delivering the mixture irrespective of flow rates within predetermined limits, and is a continuation-in-part of Serial No. 854,424, filed on November 20, 1959, now abandoned.

It is frequently necessary to mix two or more gases to provide a desired mixture, and to maintain a flow of the mixed gases to meet specified requirements. One example of such use is so-called peak shaving and standby plants which provide for the mixing of propane and air to obtain a mixture having burning characteristics comparable to natural or other gas of a primary supply to provide an auxiliary or emergency gas source. By having such an auxiliary supply source, urban gas companies are able to augment their normal supply to accommodate abnormal peak loads, and industrial plants can take advantage of the cheaper rates offered by such companies to those willing to have their normal supply cut off in times of peak load.

A number of systems have been proposed and used for this purpose, but their use has been limited due to the fact that all incorporate delicate and complicated instruments which require the attention of specially skilled mechanics. As the systems are used only at infrequent intervals, usually of short duration, suitable service personnel cannot be kept available. Still another factor attributing to the lack of widespread use is the need for closer proportion control and quicker response to variations in demand load than former systems could supply.

The general object of the present invention is to provide gas mixing apparatus which will be low in cost, as compared to other systems, and which will provide accurate control insofar as proportions are concerned with almost instantaneous response to supply and demand variations.

A more specific object of the invention is to provide apparatus of this nature wherein the gases are given equal pressure drops across orifices of fixed size to give the desired proportion of each gas to be mixed.

Another object of the invention is the provision of apparatus wherein the flow of one of the gases to be mixed is influenced and adjusted in accordance with the flow of the other gas.

Yet another object is to provide apparatus of this nature assembled and mounted as a unit, ready for installation in an emergency, or auxiliary, system.

A further object is to provide mixing apparatus which is entirely automatic in operation, and can be manually or automatically started and stopped, and which may be designed to automatically cut off in the event of abnormal conditions which would affect the desired output.

Still another object is the provision of a mixing unit having means to change the relative proportions of the gases being mixed by the pressing of a button on a control board.

A still further object of the invention is to provide an improved means for continuously mixing the proportioned gases to prevent turbulence in the mixing area.

Another object is to provide means to maintain substantially constant temperature relationship between gases being mixed.

Other objects of the invention will become apparent from the following description of practical embodiments thereof, when taken in conjunction with the drawings

which accompany, and form part of, this specification.

In the drawings:

FIGURE 1 is a top plan view of a gas mixing unit constructed in accordance with the principles of the present invention;

FIGURE 2 is a side elevation of the unit shown in FIGURE 1;

FIGURE 3 is an end elevation of the unit;

FIGURE 4 is a diagrammatic view of the operating components, and their interconnection, of a system which is slightly different from that shown in FIGURES 1 to 3, inclusive;

FIGURE 5 is a diagrammatic view of the basic system, shown in its simplest form;

FIGURE 6 is a diagrammatic view of a portion of a system in which one of the orifice valves can be controlled from a remote point to vary the feed ratio;

FIGURE 7 shows in diagram a system in which an outside air supply is used as a source of instrument air;

FIGURE 8 is a schematic illustration of part of the system with means to provide for heat exchange between the entering gases; and

FIGURE 9 is a section through an improved mixing chamber, showing the gas lines entering the chamber.

In general, the invention is concerned with the mixing of gases, such as propane and air, and the controlling of the proportions of the mixture by first controlling the pressures of the gases to be mixed and dropping the pressures of the controlled gases in numerically equal amounts through proper sized orifices prior to mixing. This, and the using of the pressure of one gas as a control medium for the pressure of the other provides an extremely accurate control both of pressures and mixture ratio.

Referring to the drawings in detail, and first adverting to FIGURE 5 there is shown schematically the basic lay-out of the present system, and the principle upon which the other illustrated forms of the invention are founded.

FIGURE 5 shows two gas lines **1** and **2**, which lead from suitable sources of gas under pressure. For purposes of this description, the line **1** will be considered a propane line and the line **2** an air line. The propane **1** has a regulator **3** controlled by a pilot **4** and, spaced from the regulator, a manually adjustable valve **5** which, after adjustment, acts as a fixed orifice. The air line includes a regulator **6**, having a pilot **7**, and a valve **8** to provide a fixed orifice in the air line. The two lines merge beyond the valves **5** and **8**, to permit the gases of the two lines to mix and flow through a feed line **9**. A regulator **10** in the feed line controls the rate of flow of the mixed gases from the apparatus. Regulator **10** may be a manually operable valve, or it may be automatic and controlled by a pilot **11**.

The purpose of the regulators **3** and **6** is to admit gas from the source lines in such quantities as to create equal pressures in the two downstream lines. The valves **5** and **8** are set so that they form fixed orifices to cause a significant pressure drop in each line prior to mixing. This pressure drop is a significant amount so that in the event of slight variation between the pressures of the two lines there will be but inconsequential change in the ratio of the final mixture.

If, for example, propane is available at eighty pounds pressure and air at fifty-five pounds pressure, and it is desired to mix the propane and air in predetermined proportions, the regulators **3** and **6** can be set to reduce the pressure and deliver the propane and air at forty-five pounds. The valves **5** and **8** will be initially adjusted and set so that flow of propane and air in their respective lines will be in desired proportions to one another and

a further and significant equal pressure drop is obtained. This second pressure drop can bring the pressures in the two lines to thirty pounds, for example. The propane and air, being reduced in numerically equal amounts through valves **5** and **8** will mix in predetermined proportion in the line **9** and be fed at a desired rate through the regulator **10**. The rate of flow through the regulator **10** will have a definite effect upon the degree of pressure drop across the valves **5** and **8** by affecting the pressure in the lines downstream of the valves **5** and **8**.

In order to maintain close control over the pressures in the line and have the system respond instantly to pressure changes, or pressure differentials, one of the regulators is controlled by a known force counteracted by the pressure in the line that regulator controls. The other regulator is controlled by its own line pressure counteracted by the pressure of the other line to make the regulator instantly responsive to differential pressure in the two lines. To accomplish this result, the propane line has its regulator **3** controlled by a diaphragm type pilot **4** which is spring loaded to the degree necessary to obtain the desired pressure in the propane line. The reduced line pressure is applied to the opposite side of the diaphragm to balance the spring load when the line pressure is proper. The line pressure is fed back to the pilot through a line **12** connecting the propane line and the pilot. The pilot **7** of the regulator **6** is connected to the air line through line **13**, and this pressure is balanced by the pressure of the propane line through line **14** bridged from line **12** to the pilot **7**. Thus, in the example given, the spring loading of pilot **4**, the propane line pressure as fed to the pilot through line **12**, the air line pressure as applied to pilot **7** through line **13** and the propane line pressure imposed on pilot **7**, through line **14** will be identical when the system is functioning properly and the pressures in the propane and air lines have been reduced to be equal and at the predetermined level. Any fluctuation from this condition will place one or both of the pilots, as the case may be, in an unbalanced condition to adjust the regulators to correct the condition.

As mentioned above, the feed regulator **10** may be manually or automatically controlled. If it is automatic, it may be controlled by line pressure, rate of flow of the propane-air mixture, rate of flow of propane, rate of flow of air, or any other desired factor. For purposes of illustration, it is shown as controlled by the line pressure of the mixed propane and air on the outlet side of the regulator. This is done by preloading the pilot **11** and imposing the line pressure in opposition through the line **15**.

The above described system can be modified for various uses. More than two gases can be mixed, if desired, by adding one or more lines to the system shown. Other improvements can be added to the basic system to make it more flexible in operation, and to adapt it to manufacture and installation as a unitary system connectible to existing sources of supply and to utility lines or equipment to be supplied.

FIGURES 1, 2 and 3, show a mixing unit which includes as a part thereof the system described. The unit is mounted upon a base **16** having a horizontally positioned rectangular frame **17** supported upon legs **18**. The frame is constructed of channel members, welded at the corners, and the legs are mounted directly beneath the corners. Suitable braces **19** are positioned diagonally at the corners to stiffen the legs and to support cross-members **20** upon which part of the mixing apparatus is mounted. Inverted U-shaped arbors **21** have their vertical legs secured to the horizontal frame **17** and are placed at spaced intervals along the frame to provide perches upon which the major part of the apparatus is mounted.

The mixing apparatus includes a propane line **22** and an air line **23**, each of which has a pair of legs connected by a U-fitting with the legs being parallel to one another and lying flat upon the arbors **21** and being secured to them. One leg of each line has an upturned elbow at its end, the elbow **24** forming a means for connecting the propane line to a source of propane supply, and the elbow **25** a means to connect the line **23** to a source of air supply. The ends of the opposite legs are connected by fittings **26** and **27** to branch lines **28, 29** and **30, 31**. The branch lines, in turn, are all connected to a fitting **32** on one end of a gas mixing and outlet line **33**.

Each of the several lines is provided with one or more valves to open and close the line and to regulate the pressure and flow in the line. The air line **23** has a manually operable cut-off valve **34** adjacent the inlet elbow **25**. This permits the line to be closed off when the unit is not in operation, and will be opened and left open when the unit is to be put in use. A check valve **35** is mounted adjacent the shut-off valve to prevent back flow of air in the line.

Next along the line is a safety valve to cut off the line in the event of predetermined malfunction of a selected part of the system. The valve is shown as a conventional air motor valve **36** adapted to close automatically upon a drop in pressure of the air supply below a selected level. An air line **37** connects the valve to a connector plate **38**, and a line **39** leads from the plate to a control panel **40**. An air pressure sampling line **41** is tapped into the air line **23**, and connects to the plate and control panel. When the air pressure drops below a predetermined minimum, a valve (not shown) operated by pressure in the line **41**, will disconnect lines **37, 39** from a source of instrument air (not shown) to permit valve **36** to operate to shut down the supply of air under pressure.

The initial control of pressure in the air line is obtained by means of a regulator valve **42**, which is mounted in the line and controlled by pilot **43**. The pilot is actuated by the pressure of the gas in the propane line by means of a pipe **45**, leading from a propane sampling line **46** tapped into the propane line downstream from the propane regulator valve. This pressure on the pilot is opposed by the pressure in the air line beyond the regulator **42**, which pressure is imposed on the pilot through line **44**.

The propane line has cut-off and check valves **47** and **48**, similar to the valves **34** and **35** in the air line. A safety motor valve **48'** is included in the propane line. The valve will be used and controlled to automatically shut off the propane line simultaneously with the valve **36** in the event of malfunction of the system.

The propane pressure is first reduced by means of a regulator valve **49** controlled by a pilot **50**. The pilot is spring loaded and this pressure is opposed by the propane line pressure beyond the regulator by means of the line **46**.

The branch lines are also controlled by valves. The several lines have shut-off valves **52, 53, 54** and **55**, and manually adjustable valves **56, 57, 58** and **59** which provide after adjustment the fixed orifices through which the gases pass. By having two lines for each gas feed line, it is possible, by opening and closing the several lines, to change the capacity of either gas line to increase or decrease the flow rate and still obtain significant pressure drops across these orifices.

It is to be noted that the propane and air lines **22** and **23** are mounted upon the arbors **21** while the mixing line **33** is supported upon the cross-members **20** of the frame. This places the gas lines above the mixing line so that gravity and gas flow can be utilized to drain off condensate which may form in the line to avoid its collection and possible freezing in the line.

The fitting **32** is enlarged at its upper end, into which the branch lines empty, to form a mixing chamber **60** for the propane and air flowing from the open branch lines.

Thus, smooth blending of the gases and free flow of the mixed gas into the line **33** is obtained.

The flow of mixed gas through the line **33** is determined by a regulator valve **61** which is controlled by a pilot **62**. The pilot is loaded in a predetermined amount by instrument air entering through line **63**, the air pressure being opposed by the outlet pressure of line **33** by means of a sampling line **64** connected to line **33** and to pilot **62**.

The mixing line may be provided with a manually operable shut-off valve **65** if desired. The line ends with a flange for coupling to the line to be supplied with mixed gas.

The pressures of the various lines, and at different points along the lines, may be sampled and shown on instruments indicated at **66** on the control panel. The sampling lines are shown at **67**. The control panel may also have appropriate control buttons **68** for starting and operating the unit. Signal lights **69** are shown for indicating whether or not the various parts of the unit are functioning properly.

It will be obvious that the unit just described will operate in substantially the same manner as the basic system previously described. It has the added advantage of additional automatic controls, and means to permit changing the range of the flow rates of the gases without changing the settings of the fixed orifices while maintaining significant pressure drops. The fact that the apparatus is made self-contained and mounted upon a base provides a unit which can be shipped and installed quickly and easily by relatively unskilled labor. The use of a control panel through which the control lines pass allows the control point to be remote from the unit and out of the zone of dangerous operation. It is to be noted that all of the controls on the mixing unit are air or gas operated so that no electrical equipment with its attendant fire, or explosion, hazard is present.

In FIGURE 4 is shown a diagrammatic layout which combines the principles of the previously described apparatus with additional equipment to provide for automatic control and push-button change-over to provide several mix proportions without changing the setting of any of the manually operable valves.

The system includes propane line **70** from a source of supply and air line **71** from a source of air under pressure. The two lines empty into a mixing line **72** which can be coupled into the line to be fed. Propane line **70** has a cut-off valve **73**, check valve **74**, safety motor valve **75**, pilot controlled regulator valve **76** and manually controlled valve **77** which provides the fixed orifice. Motor valve **75** is operated by instrument air through line **78** from a source **79**. Flow through line **78** is controlled by a pressure valve **90** inserted in the line and closed by pressure in a line **81** which leads from a pressure differential detector **89** bridged across the air and propane lines. The regulator **76** is controlled, as before, by spring loading and by propane line pressure through line **82**.

The air line **71** has shut-off valve **83**, check valve **84**, motor safety valve **85**, regulator valve **86** and orifice valve **87**. The motor valve is operated by instrument air through the line **88** under control of the pressure differential detector **89** which controls switch **90** in line **78**. Regulator **86** is controlled by air line pressure beyond the regulator through line **91** and by the propane line pressure beyond the regulator through line **92** tapped into line **82**.

The flow of mixed gases through the line **72** is controlled by regulator valve **93** which has its pilot **94** spring loaded and balanced by feeding pressure in the line **72** through line **95**.

The system of FIGURE 4 differs from those previously described in that a plurality of additional lines are provided to bridge the orifice valve **87** in the air line. The bridge lines **97**, **98** and **99** each contain a manually operable valve which can be set to define a fixed orifice, and an automatic valve which will open and close the individual lines. The orifice valves **100**, **101** and **102** are in the lines **97**, **98** and **99**, respectively, and the same lines contain the motor valves **103**, **104** and **105**. The motor valves are connected to the instrument air supply through lines **106**, **107** and **108** and controlled by push-button valves **109**, **110** and **111**. The push-button valves will be mounted upon a control panel similar to the one previously described and positioned remotely from the unit.

The orifice valves **100**, **101** and **102** may be adjusted so that each has the same setting and the motor valves may be operated to open one or more of the bridge lines to additively supplement the valve **87** and increase the capacity of the air line, or each of the valves **100**, **101** and **102** may be set at a different orifice opening and the several bridge lines opened selectively to permit their respective orifices to augment the orifice **87**. Thus, the ratio of air to propane may be changed at will. This provides a very flexible system.

The use of pressure differential between the propane and air lines as a safety control provides an accurate and simple means to prevent continued operation of the system under improper conditions. Such a safety control could not be used were it not for the fact that the basic mixing method and apparatus provides equal pressures in the propane and air lines. So long as the pressures in the two lines are equal, the system is functioning properly. If variation beyond a predetermined amount occurs improper mixing will result. By utilizing the differential as means to actuate the safety shut-off valves, the system will be automatically shut down in the event of malfunction anywhere in the system, as such malfunction will cause a pressure differential to occur.

In FIGURE 6, there is shown a portion of the basic system illustrated in FIGURE 5, but with an adjustable valve used to provide the orifice in one line, so that the ratio of the mix can be changed. In the embodiment shown, the adjustable valve **112** is shown in the air line **113**. Propane line **114** has a fixed orifice **115** as before. The two lines empty into a mixing line **116**.

Valve **112** is a motor valve, and is controlled by a variable regulator **117** which may be located at a control panel, or some other remote location. One side of the motor valve pilot is connected by line **118** with a switch source of instrument air, and the regulator **117** is in that line. The instrument air acts against a constant spring pressure in the valve pilot.

Valve **112** may be a two position valve, having limits of movement, so that two predetermined orifice settings can be obtained. It will be clear that an operator by manipulation of the variable regulator **117** at a remote point may change the orifice in the air line and thus change the propane-air ratio.

Frequently, it is desired to have the system adjust to compensate for slight differential in the pressures in the system air and propane lines. This may not be a sufficient pressure drop to operate the regulator valve properly, as the springs used in the regulators as balance loads are strong and require substantial force to overcome. This may be corrected by using an outside air source for a supply of instrument air, and controlling the instrument air in accordance with requirements. Such an arrangement is shown in FIGURE 7.

In FIGURE 7, a line **119** to be controlled includes a motor valve **120**. The motor valve has a pilot **121**, and this is controlled by a pilot regulator **122**. A line **123**, from a source of air outside the system, leads into the central chamber **124** of the pilot regulator to be controlled by the diaphragm head assembly **125** through valve **126**. Movement of the head assembly up and down opens and closes valve **126** to open and close line **123** to chamber **124**. The chamber is connected to the motor valve pilot **121** by line **127** so that outside air can be used to offset the motor valve pilot balance spring and move the valve when a line differential occurs. The diaphragm head assembly movement is controlled by differential pressures

in the air and propane lines. In the embodiment shown, line **128** connects the regulated air line (not shown) with the bottom chamber of the pilot regulator, and line **129** connects the regulated propane line **119** to the top chamber of regulator **122**. With this arrangement, a pressure drop in the propane line will cause the diaphragm head assembly **125** of the pilot regulator to rise and open valve **126** to release air pressure to the motor valve pilot **121**, to open the motor valve to increase propane flow in line **119** to bring the air and propane lines into balance. When the lines come into balance, the pressures in the top and bottom chambers of the pilot regulator will equal and the head assembly will have returned to valve closing position. Through the use of this arrangement, sufficient air pressure can be made available to insure operation of the motor valve.

It is of utmost importance to accurate control of the air and propane mixture that the relative temperatures of the elements remain constant. Temperature change will cause volume change, and if the relation of the temperatures of the air and propane does not stay substantially the same, the final mixture will vary. In order to maintain a substantially constant temperature relationship, the equipment shown in FIGURE 8 may be used.

The principal added element of the arrangement shown in FIGURE 8 is a heat exchanger **130**. This may include a shell **131** through which the propane line **132** passes. This line may run straight through the shell, or may be a coil **133** as shown. The air line **134** connects to the shell near one end to provide an inlet **135** and adjacent the opposite end to provide an outlet **136**. Suitable baffles **137** may be located within the shell to provide a tortuous path for the air for maximum contact with the propane line. It will be apparent that temperature change in either the propane or air line will result, through heat exchange, in a change in the temperature of the other. Thus, the temperature relationship will be maintained.

FIGURE 9 illustrates a mixing coupling which will serve as a connector between the air, propane and mixed gas lines, and allow the incoming air and propane to mix smoothly and progressively with gas flow, without turbulence or back pressure. The coupling **138** is in the form of a T, having a central stem **139** for connection to the mixed gas line **140** and branches **141** and **142** extending at right angles from the stem. The air and propane lines **143** and **144**, respectively, are of smaller diameter than the branch lines **141** and **142** and project through caps **145** and **146** which close the ends of the branch lines. Air and propane lines **143** and **144** project through the branch lines of the T-coupling and have their outlet ends **148** and **149** bent to lie within the stem portion of the T-member. Thus, outlet ends **147** and **148** are generally parallel to one another and to the axis of the stem **139** of the mixing coupling, and the incoming air and propane will be projected into the stem in side-by-side relation and longitudinally of the stem. By reason of this, the gases to be mixed will flow into the coupling stem while moving in the same direction, gradually and smoothly mixing without creating back pressure or turbulence. In this arrangement, the coupling stem serves as the mixing chamber.

It is believed that the operation of the several embodiments of the invention disclosed will be clear from the above description and that no additional review of the operation will be necessary.

While in the above practical embodiments of the invention have been disclosed, it will be understood that the details of construction shown and described are merely by way of example and the invention may take other forms within the scope of the appended claims.

What is claimed is:

1. The process of accurately mixing fluids of different physical characteristics to obtain a mixture of predetermined constant physical characteristics which comprises, entraining separate streams of fluids under source pressures, adjusting the pressures of the streams to substantially the same valve, maintaining the adjusted pressure substantially constant in a first one of the separate streams, controlling the pressure in a second one of the separate streams in accordance with the pressure in the first stream, reducing the pressure in each stream in substantially equal and significant amounts, and combining the separate streams of reduced pressure into a single comingled stream.

2. The process of mixing fluids as claimed in claim **1**, and controlling the flow rate of the combined stream.

3. Apparatus for accurately mixing fluids of different physical characteristics to obtain a mixture of predetermined constant physical characteristics comprising, a first fluid conduit, a second fluid conduit, and a conduit for mixed fluids connected to the first and second fluid conduits at a common point and into which the first and second conduits empty, an automatic valve in each of said conduits, means to provide a set orifice in each of said first and second conduits between the automatic valves and the connection of the first and second conduits and the mixed fluid conduit, means to operate the automatic valve in the first conduit in response to variations in pressure in the first conduit between the automatic valve and the set orifice in the first conduit, and means to operate the automatic valve in the second conduit in response to pressure differential between the first and second conduits between the automatic valves and the set orifices therein, the means to provide a set orifice in at least one of said conduits being an automatic valve, and means located remote from the apparatus to control the automatic valve providing the set orifice to change the set orifice to vary the ratio of the mix.

4. Apparatus for accurately mixing fluids of different physical characteristics to obtain a mixture of predetermined constant physical characteristics comprising, a first fluid conduit, a second fluid conduit, and a conduit for mixed fluids connected to the first and second fluid conduits at a common point and into which the first and second conduits empty, an automatic valve in each of said conduits, means to provide a set orifice in each of said first and second conduits between the automatic valves and the connection of the first and second conduits and the mixed fluid conduit, means to operate the automatic valve in the first conduit in response to variations in pressure in the first conduit between the automatic valve and the set orifice in the first conduit, and means to operate the automatic valve in the second conduit in response to pressure differential between the first and second conduits between the automatic valves and the set orifices therein, and the means to operate each automatic valve including, a pilot for each automatic valve, a pilot regulator having a valve therein responsive to pressure differentials in the said conduits, a line interconnecting the pilot regulator valve and the pilot of its respective automatic valve to provide operating fluid for the automatic valve, and means interconnecting the pilot regulator valve with a source of fluid under pressure.

5. Apparatus for accurately mixing fluids of different physical characteristics to obtain a mixture of predetermined constant physical characteristics comprising, a first fluid conduit, a second fluid conduit, and a conduit for mixed fluids connected to the first and second fluid conduits at a common point and into which the first and second conduits empty, an automatic valve in each of said conduits, means to provide a set orifice in each of said first and second conduits between the automatic valves and the connection of the first and second conduits and the mixed fluid conduit, means to operate the automatic valve in the first conduit in response to variations in pressure in the first conduit between the automatic valve and the set orifice in the first conduit, and means to operate the automatic valve in the second conduit in response to pressure differential between the first and second conduits between the automatic valves and the set orifices therein, a heat exchanger having a shell and a tubular conduit through the

shell, one of said first and second conduits including the tubular conduit through the shell and the other of said first and second conduits including the shell of the heat exchanger, said heat exchanger being located in the respective conduits upstream from the means providing the set orifices.

6. Apparatus for mixing two fluids of different characteristics to obtain a fluid of predetermined physical characteristics comprising, a base structure, a first fluid conduit and a second fluid conduit mounted upon the base in side by side relation, a conduit for mixed fluids mounted upon the base at a level below that of the first and second conduits, a vertically arranged connector including a mixing chamber coupled to the first and second conduits and to the mixed fluid conduit, an automatic valve in each of said conduits, a manually adjustable valve to provide a set orifice in each of said first and second conduits between the automatic valves and the connector, means to operate the automatic valve in the first conduit in response to variations in pressure in the first conduit between the automatic valve and the manually adjustable valve in the first conduit, and means to operate the automatic valve in the second conduit in response to pressure differential between the said variations in pressure in the first conduit and pressure variations in the second conduit between the automatic valve and the manually adjustable valve therein.

7. Apparatus for mixing two fluids of different characteristics as claimed in claim 6 wherein there is means to control the automatic valve in the fluid mixing line in response to pressure variations in the fluid mixing line downstream of said valve.

8. Apparatus for mixing two fluids of different characteristics as claimed in claim 6 wherein there is at least one conduit bridging the manually adjustable valve in one of said first and second conduits, a manually adjustable valve in the bridging conduit, and means in the bridging conduit to close and open that conduit.

9. Apparatus for mixing two fluids of different characteristics as claimed in claim 6 wherein there is at least one conduit bridging the manually adjustable valve in each of the first and second conduits, a manually adjustable valve to provide a set orifice in each bridging conduit, and means in each bridging conduit to close and open that respective conduit.

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