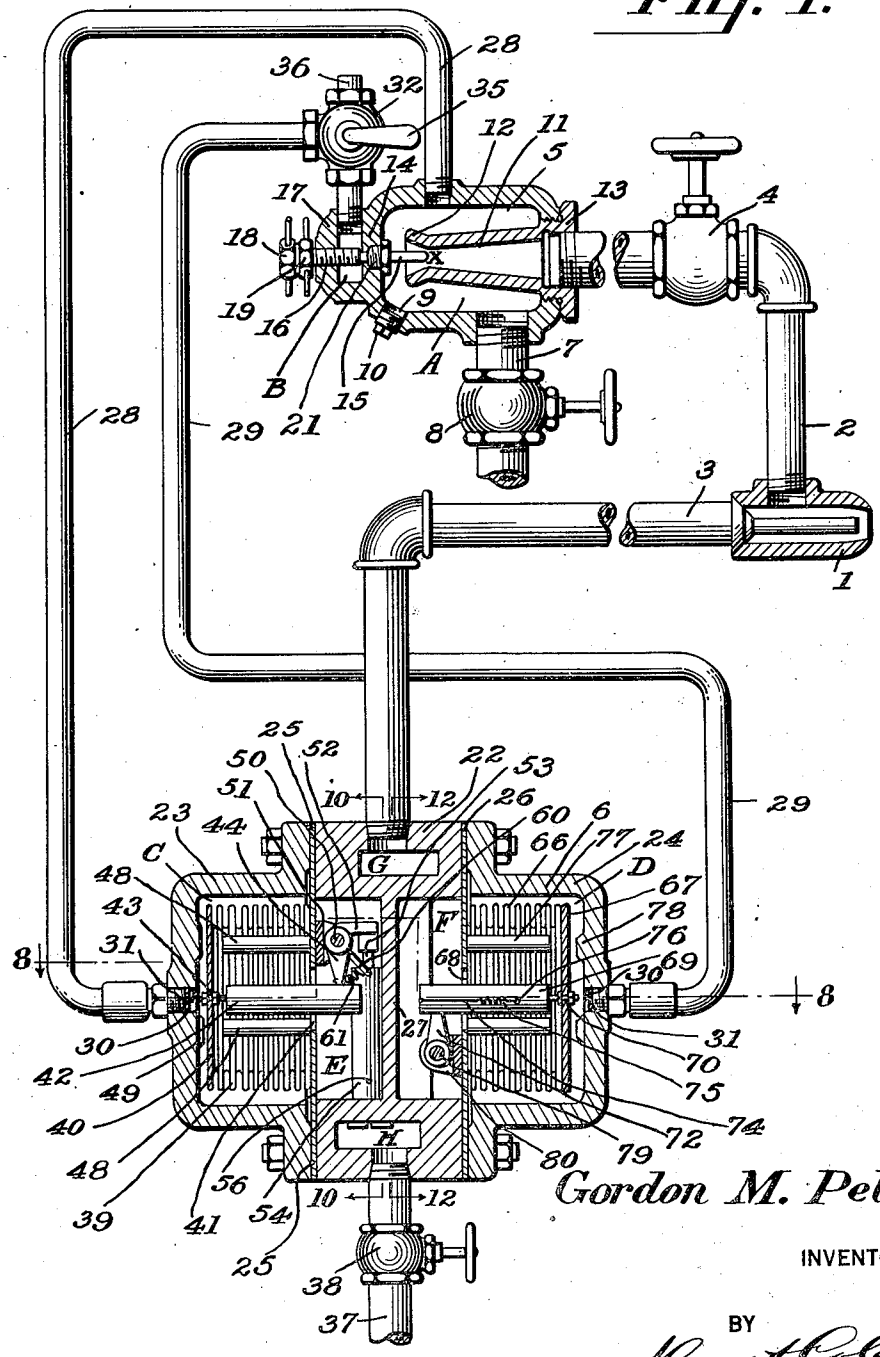
April 3, 1928. 1,665,145

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APPARATUS FOR DELIVERY OF FLUIDS TO BURNERS

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Fig. 1.



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APPARATUS FOR DELIVERY OF FLUIDS TO BURNERS

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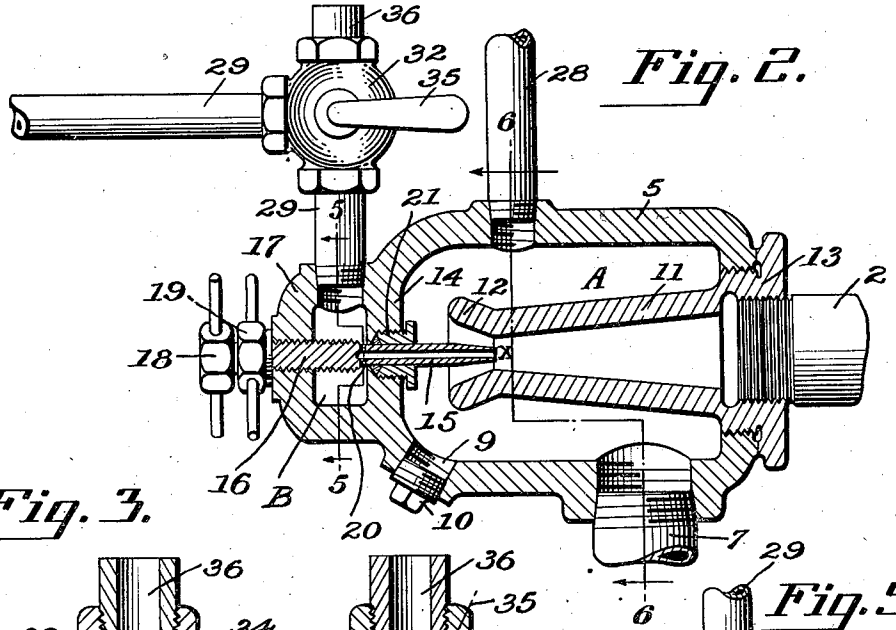


Fig. 2.

Fig. 3.

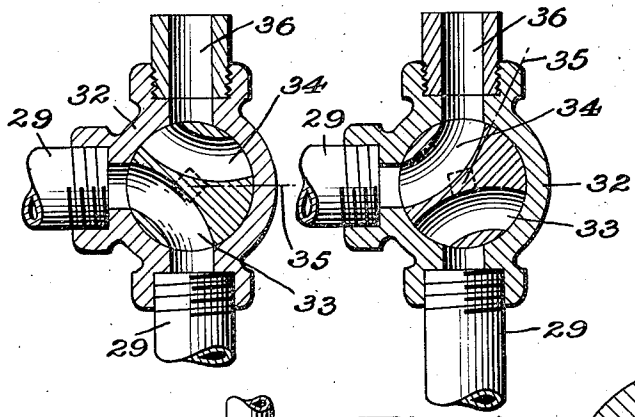


Fig. 4.

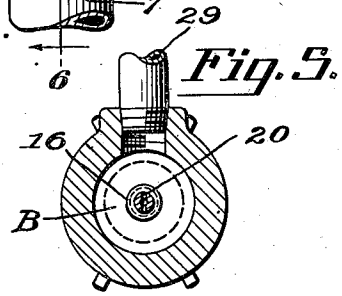


Fig. 5.

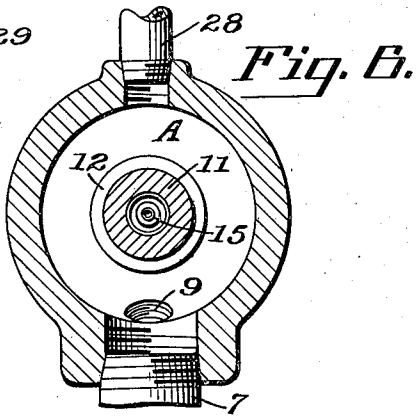


Fig. 6.

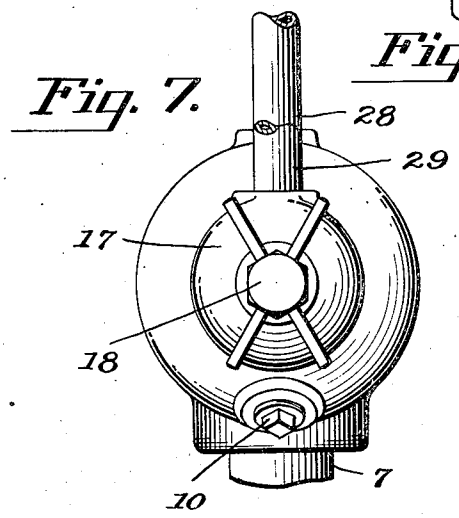


Fig. 7.

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APPARATUS FOR DELIVERY OF FLUIDS TO BURNERS

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Fig. 8.

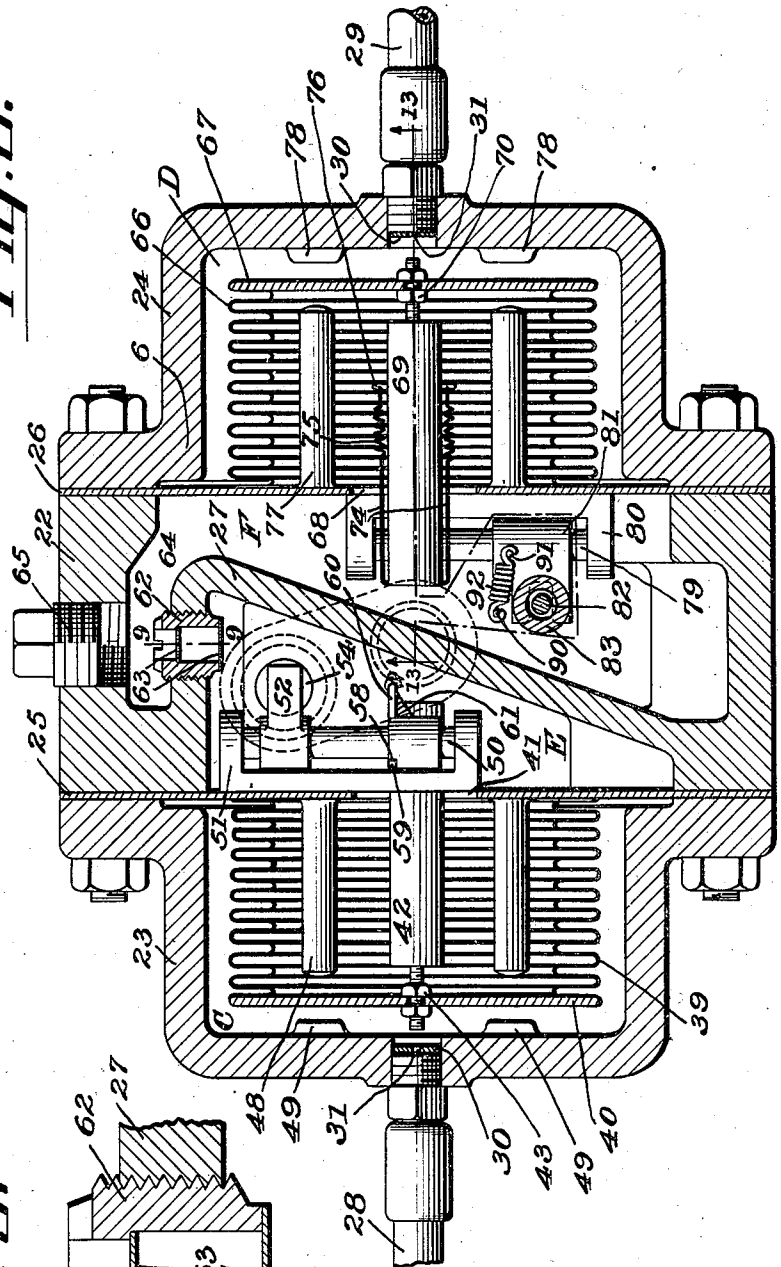


Fig. 9.

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APPARATUS FOR DELIVERY OF FLUIDS TO BURNERS

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Fig. 10.

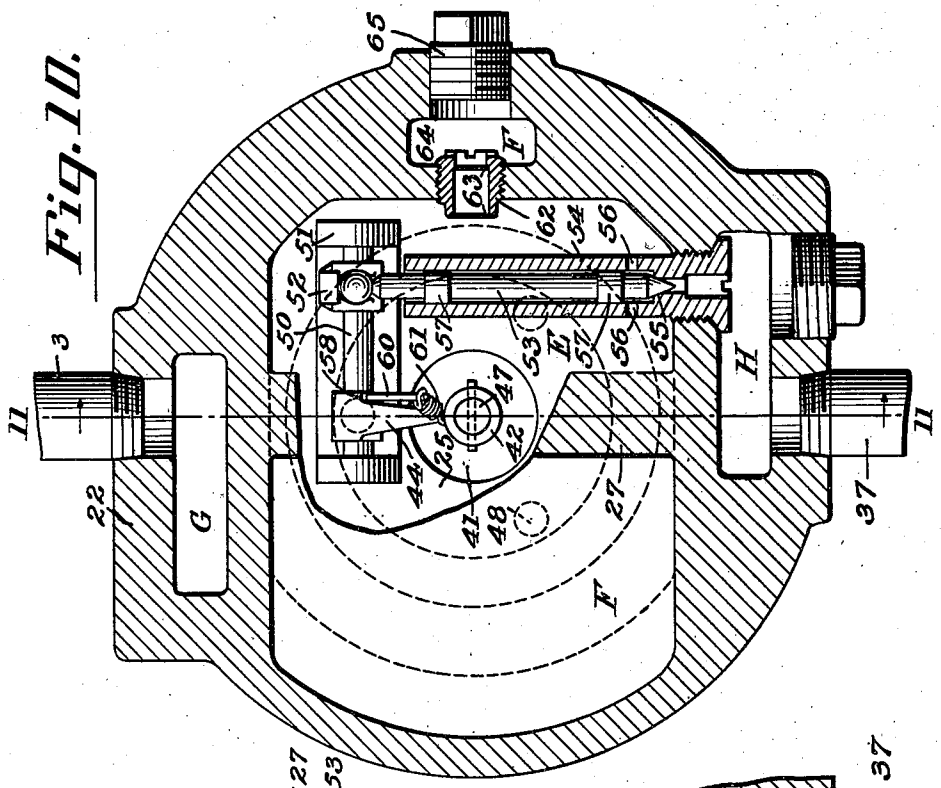
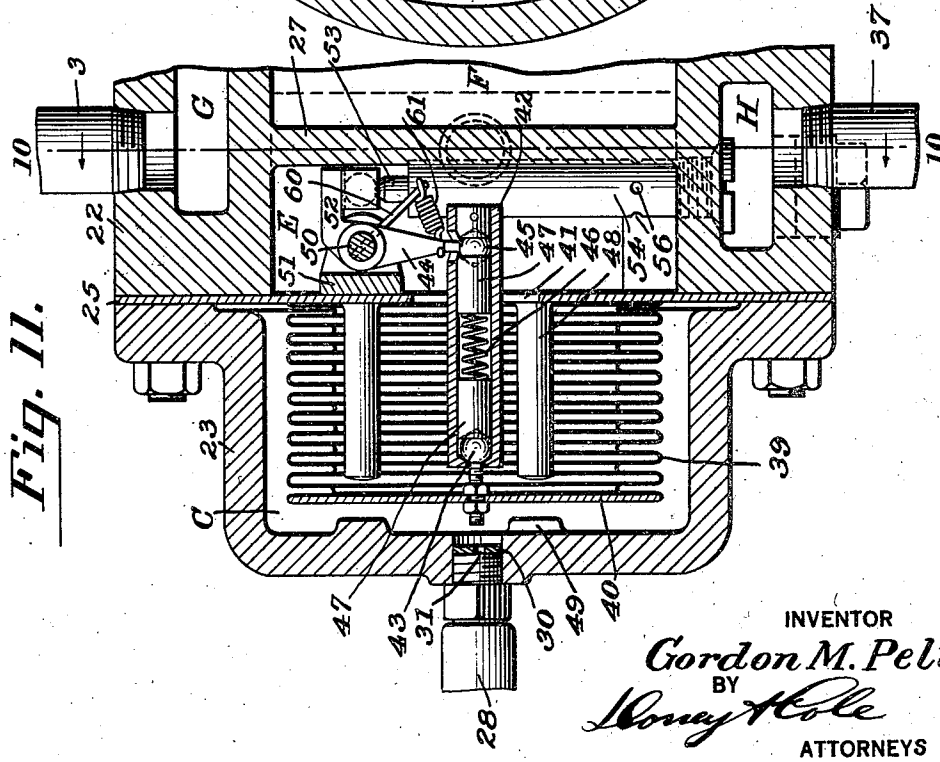


Fig. 11.



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APPARATUS FOR DELIVERY OF FLUIDS TO BURNERS

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Fig. 13.

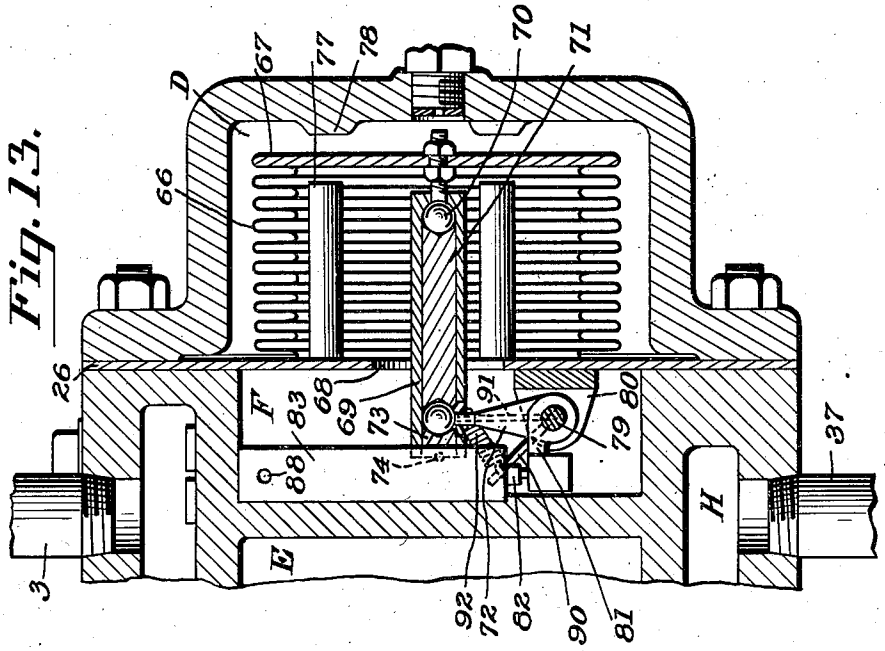
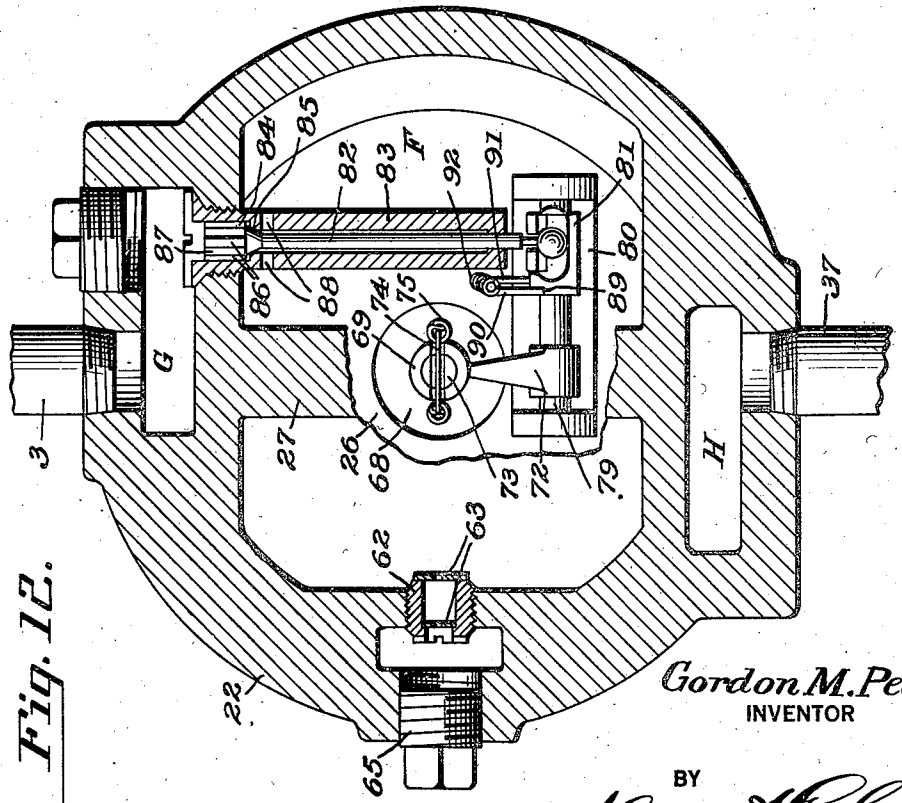


Fig. 12.



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Patented Apr. 3, 1928. 1,665,145

UNITED STATES PATENT OFFICE.

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APPARATUS FOR DELIVERY OF FLUIDS TO BURNERS.

Application filed January 25, 1924. Serial No. 688,462.

This invention relates to apparatus for maintaining proportional delivery of combustible fluids and air supplied through separate passages to burners, notwithstanding variations in the resistance to the flow of these fluids or in their relative pressures.

I am aware that there are many different types of liquid fuel burners which depend for their operation upon the use of compressed air or steam for breaking up or atomizing the combustible fluids. Such burners rely upon the high velocity of the resulting stream of air and atomized fluid to draw into the burner the necessary air for combustion. In such burners the proportion of air to combustible fluid used depends upon the adjustment of the fluid and compressed air valves.

One object of my present invention is to provide an apparatus which is so designed that the proportion of combustible fluid and air admitted to a burner is automatically controlled, and the ratio of these fluids is kept constantly at any desired point regardless of the quantity of the fuel being burned.

It is a further object of my invention to make the flow of combustible fluid dependent only on the flow of air admitted to the burner, regardless of back pressure or suction in the burner, or of resistances in the burner supply pipe.

An apparatus according to my invention consists essentially of two main parts, namely, a feeder for the air which is inserted in a compressed air line to a burner, and a feeder for the fuel which is inserted in the fuel line between a valve and the burner.

The feeder for the air comprises a conventional Venturi throat having mounted therein an adjustable Pitot tube aiming down stream and has no moving parts. Its function is to obtain a pressure difference dependent upon the amount of air flowing to the burner without restricting the flow, and to actuate the feeder for the fuel accordingly.

The feeder for the fuel consists of two main chambers that are connected by an orifice. The fuel enters one of these chambers through a needle valve operated by a diaphragm in such manner as to maintain a fuel pressure in this chamber equal to the air pressure communicated to the outside of the diaphragm from the feeder for the air. From this chamber the fuel passes through the orifice into the other chamber and out to the burner through another valve actuated by another diaphragm in such manner as to check the escape of the fuel so as to maintain a fuel pressure in this chamber equal to the air pressure communicated to its diaphragm from the feeder for the air.

With the above and other objects in view which will appear as the description progresses, my invention consists of the novel construction, combination and arrangement of parts more fully described in the following specification and particularly pointed out in the appended claims.

In the accompanying drawings:—

Figure 1, is an elevation, partly in section, of an apparatus constructed according to the preferred embodiment of my invention;

Figure 2, is an enlarged view, partly in section, of the upper portion of the apparatus shown in Figure 1, through which the air is delivered to the burner, the cut-off valve being shown in normal operating position;

Figure 3, is a detail sectional view of the cut-off valve, the valve being shown in operative position;

Figure 4, is a similar view, showing the valve in inoperative position;

Figure 5, is a transverse section, taken on the line 5—5 of Figure 2;

Figure 6, is a section taken on the line 6—6 of Figure 2;

Figure 7, is an end view of a portion of the apparatus shown in Figure 2;

Figure 8, is a horizontal section taken approximately on the line 8—8 of Figure 1, showing the portion of apparatus through which the fuel is delivered to the burner;

Figure 9, is an enlarged detail section taken on the line 9—9 of Figure 8;

Figure 10, is a transverse section taken approximately on the line 10—10 of Figure 1, parts being broken away to show the underlying structure;

Figure 11, is a section taken on the line 11—11 of Figure 10;

Figure 12, is a transverse section taken approximately on the line 12—12 of Figure 1, parts being broken away to show the underlying structure, and

Figure 13, is a section taken on the irregular line 13—13 of Figure 8.

Referring to the drawings, and particularly to Figure 1, the apparatus includes a burner 1, of any approved type, which is supplied with air under pressure through a pipe 2, and also with a combustible fluid, such as fuel oil, through a pipe 3. A suitable valve 4 is mounted in the pipe 2 behind the burner for the purpose of controlling the amount of air delivered through the pipe to the burner. It is to be understood that throughout the following description, steam can be substituted for air as the atomizing medium, without altering the construction or operation of the apparatus.

The air feeder.

Mounted in the air line at a convenient point from the burner 1, is a feeder 5 for the air, which will be hereinafter more fully described, while interposed in the fuel line, also at a convenient point from the burner 1 and also adjacent to the feeder 5, is a device 6 for feeding the fuel to the burner. As will be later on pointed out, the air feeder 5 is connected to the fuel feeder 6 so that the amount of fuel delivered to the burner 1 will be automatically controlled by the amount of air passing through the pipe 2.

The air feeder 5 is provided with a chamber A, of hollow cylindrical form, the chamber being closed to atmosphere. Threaded into the bottom of the chamber is an air supply pipe 7 having a control valve 8 therein. When the valve is open the air in the chamber A will be substantially under a constant pressure. In one end of the chamber A there is formed a drain opening 9 in which is threaded a removable plug 10. The purpose of providing the drain opening 9 is to enable accumulation of water or other foreign matter in the chamber to be quickly removed.

Mounted in the chamber A of the air feeder, in axial alignment therewith, is a Venturi throat 11, having a small flared end 12 positioned adjacent to the rear end of the chamber, and its opposite enlarged end 13 threaded into the front end of the chamber. The air pipe 2 from the burner 1 is threaded into the end 13 of the Venturi throat 11. When the valve 8 is open, the air will flow from the chamber A, through the Venturi throat 11, into the pipe 2. The Venturi throat has an area of two to three times the area of the air opening in the burner, and so the pressure drop through it will be relatively small. For this condition, the flow of air through the venturi is substantially the same as for a non-expansive fluid, and so for all practical purposes the simple Venturi laws can be used. According to these laws, neglecting friction, the total head of pressure at any point in the venturi will always be equal to the sum of the static and velocity heads, and this sum will be a constant, equal to the pressure at the Venturi entrance. Referring now to Figure 2, of the drawings, it will be noticed that for any point in the Venturi throat 11, such as is indicated at X, the static head plus the velocity head equals the total head, and therefore equals the pressure in chamber A, or the static head at X, equals the pressure in chamber A, minus the velocity head at X.

Formed integral with, but spaced from the chamber A of the air-feeder 5, is another chamber B, a wall 14 separating the two chambers. Projecting into the end 12 of the Venturi throat 11, is a Pitot tube 15 that is provided with a shank 16 threaded into the rear wall 17 of the chamber B. The outer extremity of the shank 16 is provided with a head 18 carrying oppositely extending arms by means of which the tube 15 can be manually moved in or out of the air feeder. Interposed on the shank 16 between the head 18 and the wall 17 is a nut 19, formed similarly to the head 18. By means of this nut, the tube can be locked after its tip has been adjusted to the desired position with respect to the Venturi throat 11. The portion of the tube 15 that extends from the chamber B, through the wall 14 into the end 12 of the Venturi throat 11, is hollow and the end of the tube that lies in the chamber B, is provided with transverse passages 20 (see Figure 2). This construction enables the chamber B to be in communication with the Venturi throat in chamber A. A stuffing box 21 surrounds the portion of the Pitot tube 15 that extends through the wall 14, so as to prevent leakage of the fluids from one chamber to the other.

By this construction, it will be readily seen, that the Pitot tube 15, which points down stream in the Venturi throat 11, can be adjusted from the outside so that its tip can be put at any desired position such as X.

The fuel feeder.

The fuel feeder 6 is preferably composed of three hollow castings; namely, an annular central portion 22, and opposite end castings 23 and 24 which are bolted to the portion 22. These castings, when assembled, form a housing for all of the mechanism comprising the fuel feeder.

When the ends 23 and 24 are being assembled onto the central portion 22, plates 25 and 26, which serve as gaskets are used.

These plates divide the interior of the housing into a plurality of chambers, those in the ends 23 and 24, being designated as C and D, respectively, while in the central portion are two chambers E and F, that are separated by a web 27, formed integrally in the casting. The chamber C, together with the chamber E, may be termed the inlet chamber in which the pressure responsive device 39, to be hereinafter described is mounted, and the chamber D, together with the chamber F, may be termed the outlet chamber in which the pressure responsive device 66 also to be hereinafter described, is mounted.

Chambers A and B of the air feeder 5 are connected to chambers C and D of the fuel feeder 6 by pipes 28 and 29 respectively. Fixed to the ends of these pipes, where such pipes enter the chambers C and D are discs 30, each having a small opening 31 therein. The purpose of these discs is to permit the pressure from the air feeder 5 to be communicated to chambers C and D, but to check any tendency for a rapid surging back and forth of the air, which surging would cause the burner to operate irregularly. Mounted in the pipe 29 adjacent to the air feeder 5 is a cut-off valve 32, having two ports 33 and 34 which are actuated by a key 35 (indicated by broken lines in Figures 3 and 4). When the key 35 is in substantially a horizontal position (see Figures 1, 2 and 3) port 33 of the valve will be so disposed that the air can flow directly through the pipe 29 connecting chambers B and D. This is the normal operating position. When the key 35 is thrown upwardly, as is illustrated by Figure 4, port 33 will be moved out of registration with the ends of the pipe 29, and port 34 will be so disposed that chamber B is sealed and chamber D is opened to atmosphere through a port 36 formed in the top of the valve. The purpose of this will be hereinafter more fully described.

The pipe 3 from the burner 1 is connected to a chamber G formed in the top of the central portion 22 of the fuel feeder 6, while a pipe 37, leading from the source of fuel supply is connected to a chamber H formed in the bottom of the central portion 22. The chamber G communicates with chamber F, while the chamber H communicates with chamber E. However, valves are interposed between each of these pairs of chambers to control the flow of fluid therebetween. These valves are designed to be actuated through mechanism to be hereinafter described, so that fuel, upon entering the chamber H from the supply pipe 37, is admitted to chamber E, and from such chamber passes into chamber F, in a manner to be presently described, and thence into chamber G and into the pipe 3 leading to the burner 1, the fuel being fed into the burner in the desired proportion to the air flowing into the burner from the air feeder 5. A valve 38 is placed at any point in the pipe 37 adjacent to the fuel feeder 6 for the purpose of shutting off the supply of fuel when the apparatus is not in operation.

Referring now to Figures 8, 9, 10 and 11 of the drawings, within the chamber C, of the fuel feeder 6, is a pressure-responsive device illustrated as a sylphon diaphragm 39 having bellows-like side walls which are closed at their outer extremity by a thin-plate in the form of a disc 40, and which side walls are secured to the gasket 25, the construction being such that the diaphragm is formed an integral part of the gasket and it is therefore held in position within the chamber C thereby. In making this portion of the apparatus care is taken to see that the disc 40 and the gasket 25 are sealed to the diaphragm 39, so that the points therebetween will be air tight.

The central portion of the gasket 25 is provided with an opening 41 through which projects a tubular stem 42, the outer end of the stem being swivelled to the disc 40 by a ball and socket connection 43. The inner end of the stem 42 is swivelled to the free end of a lever 44 by means of a ball and socket connection 45. For the purpose of maintaining a normal relation between the connections 43 and 45, I interpose therebetween an expansion spring 46, which is carried in the intermediate portion of the stem 42 between a pair of cylindrical blocks 47, the ends of the blocks abutting the ball and socket connections being recessed. If for any reason the mechanism directly acted upon by the expansion or contraction of the diaphragm 39 should bind, or fail to function properly, it will be seen that the spring 46 will be compressed and therefore it will serve as a shock absorber for the delicate parts of the mechanism.

As the opening 41 in the gasket 25 is relatively large, it will readily be seen that the interior of the diaphragm 39 will be directly in communication with the portion E, of the inlet chamber, and hence the pressure of any fluid within such chamber portion will also be present in the diaphragm; and, as the exterior of the diaphragm 39 is located in portion C, of the inlet chamber, the pressure of any fluid within such latter chamber portion will act against it and also against the disc 40 forming the end of the diaphragm.

Projecting into the diaphragm 39 from the face of the gasket 25 is a plurality of posts 48, which terminate adjacent to the disc 40, while formed on the inner surface of the end of the casting 23, in alignment with the posts 48 and projecting towards the disc 40, is a plurality of lugs 49. The

purpose of the posts 48 and lugs 49 is to prevent the diaphragm 39 from expanding or collapsing beyond its elastic limit in case of a heavy unbalanced pressure, as will be readily understood.

The lever 44 is mounted on one end of a rock-shaft 50 carried by a bracket 51 fixed on the opposite side of the gasket 25 from the diaphragm 39. This lever and its associated parts are therefore mounted in the chamber E of the fuel feeder. To the end of the shaft 50 opposite to the lever is fixed another lever 52, which projects from the shaft at an angle of about 90° to the lever 44, and hence it will be seen that the lever 44, shaft 50, and lever 52, form a bell-crank that is actuated by the expansion and contraction of the diaphragm 39.

The purpose of this bell-crank is to raise and lower a needle 53 swivelled to the end of the lever 52, said needle being slidably mounted in a tubular post 54 threaded into the bottom of the central portion 22, the lower end of the post being positioned in chamber H of the fuel feeder. Near the bottom of the post 54, there is formed a tapered seat 55 for the point of the needle 53. Lateral passages 56 are formed in the lower portion of the post above the seat. Therefore, when the needle 53 is seated, the flow of fuel from the chamber H to chamber E is prevented, but when the needle is raised, the fuel is free to flow upwardly into the post 54 and through the passages 56 into the chamber E. As shown by Figure 10, the needle 53 is somewhat less in diameter than the bore through the post 50. However, the needle is provided with spaced collars 57, which act as guides to keep the needle in axial alignment with its seat.

In constructing the operating mechanism for the needle 53, a safety release is incorporated in the lever elements, so as to prevent destruction of the several parts in case of a heavy unbalanced pressure tending to close the needle. The means comprising this safety release consists in providing the hub of the lever 44 with notches 58 which are normally engaged by an arm 60 and an extension thereof in the form of a stud 59, projecting through the shaft at an angle to the lever 44, said arm engaging one of the notches, while the stud engages the other notch. Connecting the extremity of the arm and the lever 44 is a coiled spring 61, (see Figs. 10 and 11). The purpose of the spring 61 is to hold the notches 58 against stud 59 and arm 60. In normal operation this will cause the lever and shaft to move together as one, but if a heavy force is exerted, threatening to destroy the mechanism, the spring 61 will expand and the stud 59 and arm 60 will ride off of the notches 58 until the disc 40 comes into contact with its stops. When the force is relieved, the spring 61 will pull the shaft 50 and the lever 44 back into their normal relation to each other. The spring 61 is stiff enough to close the needle 53 against the normal fuel pressure but not stiff enough to disrupt the mechanism.

Threaded into the wall separating chamber E from chamber F is a plug 62 carrying one or more perforated plates 63. The fuel enters chamber E through the perforations 56 in the post 54 when the needle 53 is raised. From this chamber the fuel passes through the plate or plates 63 of the plug 62 into chamber F, a passage 64 being formed in the portion 22 of the housing as a lateral extension to such chamber, as shown by Figures 8 and 10. A plug 65 is threaded into the exterior wall of the portion 22 of the housing in axial alignment with the plug 62. The plug 65 is made larger in diameter than the plug 62, so that when it is removed, the plug 62 can be withdrawn for cleaning or inspection, as will be readily understood. By providing the plug 62 with two or more perforated plates arranged in series it will be seen that a high pressure drop can be obtained without making the size of the perforations in the plates so small that they will clog.

Within the chamber D, of the fuel feeder 6 is a second pressure responsive device also illustrated as a sylphon diaphragm 66 having bellows-like side walls which are closed at their outer extremity by a thin plate in the form of a disc 67, and which side walls are secured to the gasket 26, the construction being such that the diaphragm is formed an integral part of the gasket and it is therefore held in position within the chamber D thereby. In making this portion of the apparatus care is taken to see that the disc 67 and the gasket 26 are sealed to the diaphragm 66, so that the points therebetween will be air tight.

The central portion of the gasket 26 is provided with an opening 68 through which projects a tube 69, one end of the tube being swivelled to the disc 67 by a ball and socket connection 70, while the other end of the tube projects into the chamber F. As the opening 68 in the gasket 26 is relatively large, it will readily be seen that the interior of the diaphragm 66 will be directly in communication with the chamber portion F, of the outlet chamber, and hence the pressure of any fluid within such chamber portion will also be present in the diaphragm. And as the exterior of the diaphragm 66 is located in chamber portion D of the outlet chamber, the pressure of any fluid within such latter chamber portion will act against it and also against the disc 67 forming the end thereof.

Mounted in the tube 69 is a cylindrical spacer block 71, having one end recessed for

engagement with the ball and socket connection 70, and its other end recessed for receiving the spherical end formed on the extremity of a lever 72. A cylindrical block 73 which engages the other side of the spherical end of the lever closes the end of the tube 69. The outer end of the block 73 is provided with a slot in which is inserted the cross-piece of a U-shaped yoke 74. A pair of springs 75 are connected to the free ends of the yoke 74 and to pins 76 projecting from the tube 69. The purpose of the springs 75 is to retain the parts within the tube 69 in position, but if for any reason the mechanism directly acted on by the parts should bind, or fail to function properly, it will be seen that the springs will expand thereby relieving such pressure.

Projecting into the diaphragm 66 from the face of the gasket 26 is a plurality of posts 77, which terminate adjacent to the outer extremity of the diaphragm, while formed on the inner surface of the end wall of the casting 24 in alignment with the posts 77 and projecting towards the disc 67, is a plurality of lugs 78. The purpose of the posts 77 and lugs 78 is to prevent the diaphragm 66 from expanding or collapsing beyond its elastic limit in case of a heavy unbalanced pressure, as will be readily understood.

The lever 72 is mounted on one end of a rock-shaft 79 carried by a bracket 80 fixed on the opposite side of the gasket 26 from the diaphragm 66, the lever and its associated parts therefore being mounted in the chamber F. To the end of the shaft 79 opposite to the lever 72 is mounted another lever 81 which projects from the shaft at an angle of about 90° to the lever 72, and hence it will be seen that the lever 72, shaft 79, and lever 81, form a bell-crank, that is actuated by the expansion and contraction of the diaphragm 66.

The purpose of this bell-crank is to raise and lower a valve 82 swivelled to the end of lever 81, said valve being slidably mounted in a tubular post 83 threaded into the top of the central portion 22 of the fuel feeder, the head of the post being located in chamber G. In this manner the post serves as means for connecting chambers F and G and allowing the flow of fuel therebetween when the valve is raised. The upper end of the valve is provided with an enlarged head 84, the lower portion of which is tapered so as to engage a correspondingly formed seat 85 formed in the post 83. The interior of the post above the seat 85 is enlarged, and the head 84 has formed thereon longitudinal ribs 86, which act as guides to hold the valve head in axial alignment with its seat, while the lower end of the valve is guided by the bottom of the post 83. Between the ribs 86 are grooves 87 which are provided so that the fuel can pass unrestrictedly from the chamber F to the chamber G when the valve is raised, the fuel entering the post 83 through lateral passages 88 located below the seat 85. When the valve head 84 is seated, the fuel is retained in chamber F, but when the valve head is raised off of its seat, the fuel in chamber F is free to pass upwardly through the post 83 into the chamber G from whence it flows through the pipe 3 to the burner.

In constructing the operating mechanism for the valve 82, a safety release is incorporated in the lever elements so as to prevent destruction of the several parts in case of a heavy unbalanced pressure tending to close the valve. The means comprising this safety release consists in providing the hub of the lever 81 with a notch 89, which is normally engaged by a pin 90 projecting from the shaft 79 at an angle to the lever. Projecting from the lever 81 at an angle to the pin 90 is an arm 91. Connecting the extremity of the arm and the pin is a coiled spring 92 (see Figures 12 and 13). The purpose of the spring 92 is to hold the notch 89 against the pin 90. In normal operation this will cause the lever and shaft to move together as one, but if a heavy force is exerted, threatening to destroy the mechanism, the spring 92 will expand and the pin 90 will ride off of the notch 89 until the disc 67 comes into contact with its stop. When the force is relieved, the spring 92 will pull the shaft 79 and the lever 81 back into their normal relation with each other.

Operation.

With the parts of the air feeder in the position shown by the drawings, the Pitot tube 15 will read the static pressure at its tip minus the velocity head at the same point.

As this reading or pressure is communicated to chamber B, it can be stated that the pressure in chamber B equals the static head at X minus the velocity head at X. Substituting the value for static head as mentioned above it will be seen that the pressure in chamber B equals the pressure in chamber A minus twice the velocity head at X. In other words, the pressure difference between chamber A and chamber B will be double the velocity head at the tip of the Pitot tube 21.

Velocity head is proportional to the square of the weight of air passing per second, therefore the pressure difference between chamber A and chamber B is proportional to the rate of air flow squared. As chambers A and B of the air feeder 5 are connected to chambers C and D of the fuel feeder 6, by the pipes 28 and 29 respectively, then the pressure in chamber C will equal the pressure in chamber A and the pressure

in chamber D will equal the pressure in chamber B.

Assuming that the valves 8 and 38 are open and the valve 4 is closed, as the valve 4 is opened the air in chamber A commences to flow through the Venturi tube 11 into the pipe 2. This movement of the air is transferred as above described to the diaphragms 39 and 66 in the fuel feeder. The diaphragm 39 and the mechanism actuating valve 53 are located on the incoming side of the fuel feeder, and are so arranged that the fuel will be admitted to chamber E, until the fuel pressure in chamber E becomes equal to the air pressure in chamber C, and will then maintain this equality automatically.

From chamber E the fuel flows through the plug 62 into chamber F, building up the fuel pressure in such chamber until it balances the air pressure in chamber D. Then the outlet valve 82 will rise and allow the fuel to flow to the burner while maintaining the pressure in chamber F equal to that in chamber D. Therefore, it is evident that at all times the pressure in chamber A equals the pressure in chamber C which equals the pressure in chamber E, and the pressure in chamber B equals the pressure in chamber D which equals the pressure in chamber F. The pressure in chamber A less the pressure in chamber B is proportional to the weight of the air passing per second squared, therefore the pressure in chamber E minus the pressure in chamber F is proportional to the weight of the air passing per second squared. In other words, the pressure difference through the perforations in the plates 63 of the plug 62 is proportional to the square of the weight of air flowing. In any apparatus of this character having a plug provided with perforated plates 63, the rate of flow of a liquid is proportional to the square-root of the pressure difference across it, and therefore the weight of fuel passing per second is proportional to the square-root of the pressure in chamber E minus the pressure in chamber F, but the pressure in chamber E minus the pressure in chamber F is proportional to the weight of the air passing per second squared, therefore the weight of fuel passing per second is proportional to the square-root of the weight of the air passing per second squared, or the weight of the fuel passing per second is proportional to the weight of the air passing per second. That is to say the ratio of air to fuel delivered to the burner through pipes 2 and 3 will be constant.

As the flow of combustible fluid is controlled only by the difference between the pressures in chambers E and F, the flow will not be affected by any pressure or suction developed between the fuel feeder and the burner, so long as this does not exceed the pressure in chamber F.

In the operation of the apparatus, the valve 4 is opened slightly, thereby allowing a slight amount of air to escape through the burner. Then the valve 38 is opened completely, admitting fuel to the fuel feeder 6. The feeder 6 being actuated by the air-feeder 5 allows the proper amount of fuel, corresponding to the air being used, to flow to the burner and if a lighted torch be held in front of the burner it will be ignited. To alter the amount of heat supplied by the burner it is necessary only to open or shut the valve 4 in the air line. To shut down the burner the valve 38 is first closed completely and then the valve 4 is closed. To alter the ratio of fuel to air being used, the Pitot tube 11 is screwed in to supply more fuel or out for less. When adjusted it is fastened in place by the lock nut 19. Large changes in adjustment permitting the apparatus to be adapted to burners of various sizes and types can be made by altering the sizes of the perforations in the plug 62 and the throat 11.

One purpose of the valve 32 is to enable priming of the burner when the same is cold, without altering the adjustment of the air and fuel mixture. When the valve is turned to the position shown by Figure 4 to break the line from chamber B to D chamber D will be opened to atmosphere. Releasing the pressure in chamber D causes the diaphragm 66 to move outward to its limit, thereby opening the valve 82 wide. This causes a complete loss of pressure in chamber F. Chamber E will still contain fuel at pressure equal to that in chamber A which will result in a greatly increased flow of fuel. This flow can be checked and controlled by means of valve 38, in which case the pressure in chamber E will be lost and the pressure in chamber C will cause diaphragm 39 to move inwardly to its limit, opening valve 53 wide.

The burner can now be operated by manipulating valves 4 and 8 in the usual manner, the feeder being entirely out of operation. Upon throwing the valve 32 into the operating position, the pressure in chamber B will be again communicated to chamber D and this causes the outlet valve 82 to close until the pressure in chamber F equals the pressure in chamber D. This action reestablishes the pressure in chamber E bringing the inlet valve 53 back into its normal position. Valve 38 is then opened wide and the feeder will function.

This feature is very valuable and important, because it is practically impossible to start up a cold burner on an oil-air ratio that would be satisfactory after the burner became hot. Without the valve 32, it would be necessary, therefore, to alter the mixture adjustment every time the burner was lighted up. By starting the burner with the

valve 32 moved to break the line between chambers B and D and then throwing such chambers into communication with each other when the burner has become hot, the mixture adjustment can be left fixed so that the same conditions can be obtained, even though the burner is extinguished periodically.

The valve 32 also provides a quick and convenient way of flushing out the valves 53 and 82 in case sediment collects under them. This can be done without taking anything apart, without changing adjustments, and without interrupting the fire, except there will be a heavy flow of oil to the burner during the flushing process.

The foregoing detailed description has been given for purposes of illustration, and no undue limitations should be deduced therefrom, but the following claims should be construed as broadly as permissible, in view of the prior art.

Having thus described my invention what I claim as new, and desire to secure by Letters Patent is:—

1. The combination with a burner having air supply and fuel supply lines, of an air feeder in the air supply line including a chamber subjected to the pressure in the air supply line, and a second chamber, means for obtaining a pressure difference between these chambers dependent on the quantity of air passing to the burner, and a fuel feeder in the fuel supply line through which the fuel passes, including an inlet valve having operating mechanism under control of the pressure in the first chamber, and an outlet valve having operating mechanism under control of the pressure in the second chamber.

2. The combination with a burner having air supply and fuel supply lines, of an air feeder in the air supply line including a chamber subjected to the pressure in the air supply line, and a second chamber, means for obtaining a pressure difference between these chambers dependent on the quantity of air passing to the burner, and a fuel feeder in the fuel supply line including an inlet valve having operating mechanism under control of the pressure in the first chamber, and an outlet valve having operating mechanism under control of the pressure in the second chamber, and means whereby the pressure difference between the chambers may be varied.

3. The combination with a burner having air supply and fuel supply lines, of an air-feeder in the air supply line including a chamber subjected to the pressure in the air supply line, and a second chamber, means for obtaining a pressure difference between these chambers dependent on the quantity of air passing to the burner, and a fuel feeder in the fuel supply line including an inlet valve having operating mechanism under control of the pressure in the first chamber, and an outlet valve having operating mechanism under control of the pressure in the second chamber, and means for maintaining a pressure drop between the said valves.

4. The combination with a burner having air supply and fuel supply lines, of an air feeder in the air supply line including a chamber subjected to the pressure in the air supply line, and a second chamber, means for obtaining a pressure difference between these chambers dependent on the quantity of air passing to the burner, and a fuel feeder in the fuel supply line including an inlet valve having operating mechanism under control of the pressure in the first chamber, and an outlet valve having operating mechanism under control of the pressure in the second chamber, and means whereby the pressure controlling the operating mechanism of the outlet valve may be released at will.

5. The combination with a burner having air supply and fuel supply lines, of an air feeder in the air supply line including a chamber subjected to the pressure in the air supply line, and a second chamber, means for obtaining a pressure difference between these chambers dependent on the quantity of air passing to the burner, and a fuel feeder in the fuel supply line including an inlet valve having operating mechanism under control of the pressure in the first chamber, and an outlet valve having operating mechanism under control of the pressure in the second chamber, and means whereby the pressure controlling the operating mechanism of the outlet valve may be released at will without affecting the pressure controlling the operating mechanism of the inlet valve.

6. The combination with a burner having air supply and fuel supply lines, of an air feeder in the air supply line including a chamber subjected to the pressure in the air supply line, and a second chamber, means for obtaining a pressure difference between these chambers dependent on the quantity of air passing to the burner, said means being adjustable for varying the pressure difference, a fuel feeder in the fuel supply line including an inlet valve having operating mechanism under control of the pressure in the first chamber, and an outlet valve having operating mechanism under control of the pressure in the second chamber, and means for maintaining a pressure drop between the said valves.

7. The combination with a burner having air supply and fuel supply lines, of an air feeder in the air supply line including a chamber subjected to the pressure in the air supply line, and a second chamber, means

for obtaining a pressure difference between these chambers dependent on the quantity of air passing to the burner, said means being adjustable for varying the pressure difference, a fuel feeder in the fuel supply line including an inlet valve having operating mechanism under control of the pressure in the first chamber, and an outlet valve having operating mechanism under control of the pressure in the second chamber, and means whereby the pressure controlling the operating mechanism of the outlet valve may be released at will.

8. The combination with a burner having air supply and fuel supply lines, of an air feeder in the air supply line including a chamber subjected to the pressure in the air supply line, and a second chamber, means for obtaining a pressure difference between these chambers dependent on the quantity of air passing to the burner, said means being adjustable for varying the pressure difference, a fuel feeder in the fuel supply line including an inlet valve having operating mechanism under control of the pressure in the first chamber, and an outlet valve having operating mechanism under control of the pressure in the second chamber, means for maintaining a pressure drop between the said valves, and means whereby the pressure controlling the operating mechanism of the outlet valve may be released at will.

9. The combination with a burner having air supply and fuel supply lines, of an air feeder in the air supply line including a chamber subjected to the pressure in the air supply line, and a second chamber, means for obtaining a pressure difference between these chambers dependent on the quantity of air passing to the burner, said means being adjustable for varying the pressure difference, a fuel feeder in the fuel supply line including an inlet valve having operating mechanism under control of the pressure in the first chamber, and an outlet valve having operating mechanism under control of the pressure in the second chamber, means for maintaining a pressure drop between the said valves, and means whereby the pressure controlling the operating mechanism of the outlet valve may be released at will without affecting the pressure controlling the operating mechanism of the inlet valve.

10. The combination with a burner, of an air feeder including a chamber subjected to the pressure of the air supply for the burner, and a second chamber, means for maintaining a pressure in the second chamber which differs from the pressure in the first chamber by an amount dependent on the quantity of air passing to the burner, and a fuel feeder having inlet and outlet valves, respectively, under control of the pressures in the said chamber and said second chamber.

11. The combination with a burner, of an air feeder including a chamber subjected to the pressure of the air supply for the burner, and a second chamber, means for maintaining a pressure in the second chamber which differs from the pressure in the first chamber by an amount dependent on the quantity of air passing to the burner, a fuel feeder having inlet and outlet valves, respectively, under control of the pressures in the said chamber and said second chamber, and means whereby the pressure difference between the chambers may be varied.

12. The combination with a burner, of an air feeder including a chamber subjected to the pressure of the air supply for the burner, and a second chamber, means for maintaining a pressure in the second chamber which differs from the pressure in the first chamber by an amount dependent on the quantity of air passing to the burner, a fuel feeder having inlet and outlet valves, respectively, under control of the pressures in the said chamber and said second chamber, means whereby the pressure difference between the chambers may be varied, and means for maintaining a pressure drop between the said valves.

13. The combination with a burner, of an air feeder including a chamber subjected to the pressure of the air supply for the burner, and a second chamber, means for maintaining a pressure in the second chamber which differs from the pressure in the first chamber by an amount dependent on the quantity of air passing to the burner, a fuel feeder having inlet and outlet valves, respectively, under control of the pressures in the said chamber and said second chamber, means whereby the pressure difference between the chambers may be varied, means for maintaining a pressure drop between the said valves, and means whereby the pressure controlling the outlet valve may be released at will.

14. The combination with a burner, of an air feeder including a chamber subjected to the pressure of the air supply for the burner, and a second chamber, means for maintaining a pressure in the second chamber which differs from the pressure in the first chamber by an amount dependent on the quantity of air passing to the burner, a fuel feeder having inlet and outlet valves, respectively, under control of the pressures in the said chamber and said second chamber, means whereby the pressure difference between the chambers may be varied, means for maintaining a pressure drop between the said valves, and means whereby the pressure controlling the outlet valve may be released at will without affecting the pressure controlling the inlet valve.

15. The combination with a burner, of an air feeder including a chamber subjected to

the pressure of the air supply for the burner, and a second chamber, means for maintaining a pressure in the second chamber which differs from the pressure in the first chamber by an amount dependent on the quantity of air passing to the burner, said means being adjustable for varying the pressure difference, and a fuel feeder having inlet and outlet valves respectively, under control of the pressures in the said chamber and said second chamber.

16. The combination with a burner, of an air feeder including a chamber subjected to the pressure of the air supply for the burner, and a second chamber, means for maintaining a pressure in the second chamber which differs from the pressure in the first chamber by an amount dependent on the quantity of air passing to the burner, said means being adjustable for varying the pressure difference, a fuel feeder having inlet and outlet valves, respectively under control of the pressure in the said chamber and said second chamber, and means for maintaining a pressure drop between the said valves.

17. The combination with a burner, of an air feeder including a chamber subjected to the pressure of the air supply for the burner, and a second chamber, means for maintaining a pressure in the second chamber which differs from the pressure in the first chamber by an amount dependent on the quantity of air passing to the burner, said means being adjustable for varying the pressure difference, a fuel feeder having inlet and outlet valves, respectively, under control of the pressure in the said chamber, and said second chamber, means for maintaining a pressure drop between the said valve, and means whereby the pressure controlling the outlet valve may be released at will.

18. In an apparatus of the class described, an air feeder including separate chambers subjected to pressures which differ by an amount dependent upon the quantity of air passing through one of said chambers, a fuel feeder including an inlet chamber and an outlet chamber, and means for maintaining a pressure drop therebetween, a diaghragm in each of the fuel feeder chambers, said diaphragms being respectively subjected on one side of the pressures maintained in the respective chambers of the air feeder, and on their opposite side to the fuel pressures in the respective fuel feeder chambers, an inlet valve under control of the diaphragm in the inlet chamber, and an outlet valve under control of the diaphragm in the outlet chamber.

19. In an apparatus of the class described, an air feeder including separate chambers subjected to pressures which differ by an amount dependent upon the quantity of air passing through one of said chambers, a fuel feeder including an inlet chamber and an outlet chamber, and means for maintaining a pressure drop therebetween, a diaphragm in each of the fuel-feeder chambers, said diaphragms being respectively subjected on one side to the pressures maintained in the respective chambers of the air feeder, and on the other side to the fuel pressures in the respective fuel feeder chambers, and fuel inlet and outlet control means under control of the respective diaphragms.

20. In an apparatus of the class described, an air feeder including separate chambers subjected to pressures which differ by an amount dependent upon the quantity of air passing through one of said chambers, a fuel feeder including an inlet chamber and an outlet chamber, and means for maintaining a pressure drop therebetween, a diaphragm in each of the fuel feeder chambers, said diaphragms being respectively subjected on one side to the pressures maintained in the respective chambers of the air feeder, and on the other side to the fuel pressures in the respective fuel feeder chambers, fuel inlet and outlet control means under control of the respective diaphragms, and means whereby the air feeder chamber pressure on the diaphragm controlling the outlet control means may be released at will.

21. In an apparatus of the class described, an air feeder including separate chambers subjected to pressures which differ by an amount dependent upon the quantity of air passing through one of said chambers, a fuel feeder including an inlet chamber and an outlet chamber, and means for maintaining a pressure drop therebetween, a diaphragm in each of the fuel feeder chambers, said diaphragms being respectively subjected on one side to the pressures maintained in the respective chambers of the air feeder, and on the other side to the fuel pressures in the respective fuel feeder chambers, fuel inlet and outlet control means under control of the respective diaphragms, and means whereby the difference between the pressures in the air feeder chambers may be varied at will.

22. In an apparatus of the class described, an air feeder including separate chambers subjected to pressures which differ by an amount dependent upon the quantity of air passing through one of said chambers, a fuel feeder including an inlet chamber and an outlet chamber, and means for maintaining a pressure drop therebetween, a diaphragm in each of the fuel feeder chambers, said diaphragms being respectively subjected on one side to the pressures maintained in the respective chambers of the air feeder, and on the other side to the fuel pressures in the respective fuel feeder chambers, fuel inlet and outlet control means under control of the respective diaphragms, means whereby the air feeder chamber pressure on the diaphragm controlling the outlet control means

may be released at will, and means whereby the difference between the pressures in the air feeder chambers may be varied at will.

23. In an apparatus of the class described, a fuel feeder having inlet and outlet ports, and means for maintaining a pressure drop therebetween, pressure responsive devices respectively controlling the inlet and outlet ports, means for subjecting the pressure responsive devices to different pressures, means for varying this difference at will, and means for releasing the pressure on one of the pressure responsive devices at will.

24. The combination with a burner, of a fuel-feeder including inlet and outlet ports through which the fuel flows to the burner, and including pressure responsive means controlling the ports, and means operated by the air supply to the burner for automatically maintaining such pressures on the pressure responsive devices as to effect a flow of fuel having a constant ratio to the air delivered to the burner.

25. The combination with a burner, of an air feeder including a chamber inserted in the air line to the burner, a Venturi throat in said chamber through which the air supply passes, a second chamber, a Pitot tube arranged in the Venturi throat and communicating with the second chamber, and fuel control pressure responsive devices respectively in communication with said chambers.

26. The combination with a burner, of an air feeder including a chamber inserted in the air line to the burner, a Venturi throat in said chamber through which the air supply passes, a second chamber, a Pitot tube arranged in the Venturi throat and communicating with the second chamber, said Pitot tube being adjustable relatively to the Venturi throat, and fuel control pressure responsive devices respectively in communication with said chambers.

27. The combination with a burner, of an air feeder including a chamber under pressure of an air supply to the burner, a second chamber, means for obtaining a pressure difference between these chambers dependent on the quantity of air passing to the burner, said means being adjustable for varying this difference, and fuel control pressure responsive devices respectively in communication with said chambers.

In testimony whereof I hereunto affix my signature.

GORDON M. PELTZ.