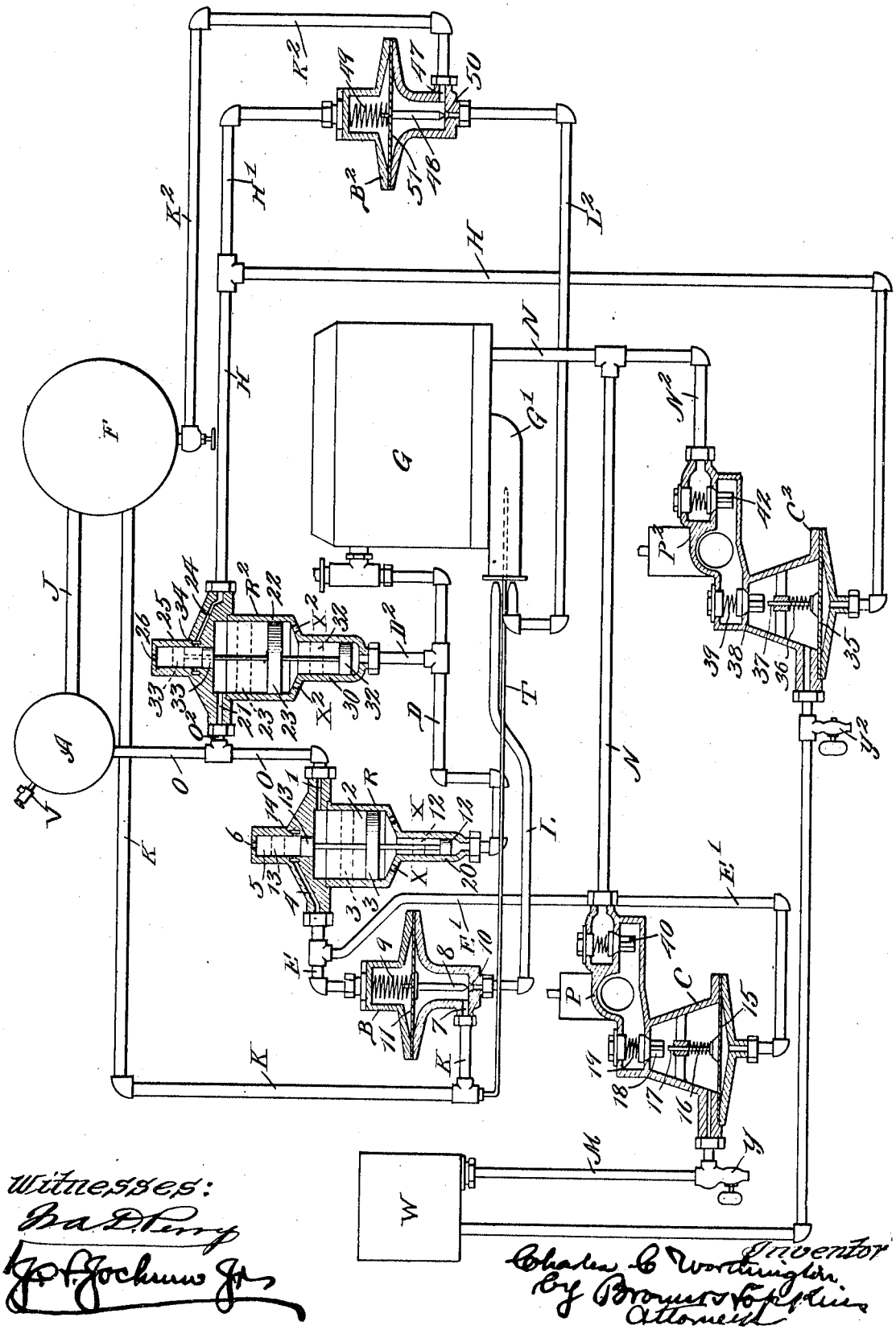
C. C. WORTHINGTON.

FEEDER FOR STEAM BOILERS AND GENERATORS.

APPLICATION FILED JAN. 27, 1909.

1,026,192.

Patented May 14, 1912.



Witnesses:

Inventor

Charles C. Worthington.

By Brownell & Hopkins

Attorneys

UNITED STATES PATENT OFFICE.

CHARLES C. WORTHINGTON, OF DUNNFIELD, NEW JERSEY.

FEEDER FOR STEAM BOILERS AND GENERATORS.

1,026,192. Specification of Letters Patent. Patented May 14, 1912.

Application filed January 27, 1909. Serial No. 474,586.

To all whom it may concern:

Be it known that I, CHARLES C. WORTHINGTON, a citizen of the United States, residing at Dunnfield, in the county of Warren and State of New Jersey, have invented a certain new and useful Improvement in Feeders for Steam Boilers and Generators, of which the following is a full, clear, and exact specification, reference being had to the accompanying drawings.

The object of the invention is to provide an improved apparatus which shall automatically control the supply of an additional amount of feed water and fuel to the generator or boiler at such times as the boiler is required to furnish more steam than can be produced from the feed water and fuel ordinarily supplied to it.

In the regular operation of a steam motor carriage, more particularly when engaged in commercial or heavy traffic service, it will frequently occur when climbing heavy grades or when the vehicle is very heavily loaded that the engine is called upon to supply a much greater amount of power than is ordinarily required. This invention is especially adapted for automatically supplying to the boiler of a steam motor carriage the increased amount of feed water and fuel required to produce the additional supply of steam necessary for the operation of the engine at such times.

The invention is in the nature of an improvement on the invention which forms the subject matter of my co-pending application Serial No. 474,580, filed January 27, 1909, and consists in the construction and combination of parts hereinafter described, and pointed out definitely in the claims.

In the drawing, the figure shows a diagrammatic view with some of the parts in section of the arrangement of this improved apparatus, the various parts of which may be placed in horizontal or vertical or any other convenient positions.

Referring to the parts by letters, and in the present exemplification of the invention: A represents an air tank in which any desired pressure is maintained, either by the operation of an air pump driven by hand or by power, or by other well known or convenient means.

F represents a fuel supply tank for containing gasolene, kerosene or other liquid fuels.

W represents a water tank for containing the supply of water.

G represents a steam generator, preferably of the flush type for evaporating the water and supplying the steam, the generator being provided with any suitable form of burner G′ consuming liquid fuel. A pilot tube T may also be provided for lighting the burner and which may preferably receive its supply from the same source as the burner G′.

R represents a regulator for regulating the supply of water and fuel to the generator G.

B represents a fuel controller for governing the admission of fuel to the burner of the generator G.

P represents a feed pump driven by power or any convenient means for forcing the supply of water into the generator G. The feed pump is constructed in combination with a controller or governor located at the base of the suction chamber of the pump, and which has communication with the suction chamber.

C designates generally the water controller governing the suction valve of the feed pump P. Water is supplied to the feed pump P through the pipe M, leading from the supply tank and entering the suction chamber of the pump at its lowest point and above the diaphragm 15 and said chamber may be drained on one side of the diaphragm through a suitable drain cock Y.

The feed pump P is connected to the generator G by the pipe N. The regulator R is connected to the generator G by the steam pipe D, and also to the fuel controller B by an air pipe E and to the water controller C by the air pipe E′.

Air is admitted to the fuel supply tank F from the tank A by means of the pipe J thus maintaining the same pressure in the fuel supply tank as in the air tank A. Fuel is admitted to the generator G from the tank F, through the pipes K and L between which pipes is located the fuel controller B and with which both pipes have communication; the pipe L being controlled by the fuel controller B through the medium of the valve 8.

Any desired pressure may be maintained in the air tank A. For general purposes a pressure of fifty pounds per square inch will be found to be ample. The pressure from the air tank A is carried through the pipe O to the regulator R, where it is admitted by the port 1 to the cylinder 2. Communicating with the cylinder 2 is a cylinder 5 having a port 6 through which the latter cylinder has communication with the atmosphere. Arranged preferably in the wall of the cylinder 5, beyond the cylinder 2 is an annular chamber 14 which has communication with the cylinder 5 and also with the port 4. A piston 13 is arranged within the cylinder 5 and is connected to move with the piston 3. The annular chamber 14 and the port 4 are so located with respect to the cylinder 2 that when the piston 3 is moved in one direction the piston 13 is adapted to assume a position between the cylinder 2 and the chamber 14 to cut off communication between the chamber and the cylinder 5 (as shown in full lines in the drawing). When the piston 3 is moved in the opposite direction, the piston 13 is adapted to assume a position between the chamber 14 and the port 6 to prevent the escape of air to the atmosphere through the port and to reestablish communication between the chamber 14 and the cylinder 2 (as shown in dotted lines in the drawing). The cylinder 2 is provided with ports X—X on the side of the piston opposite to the side on which the cylinder 5 is located whereby said cylinder 2 will always have communication with the atmosphere so as not to retard the movement of the piston 3. The pressure from the air tank A is carried also to the fuel supply tank F through the pipe J forcing the gasolene or other fluid fuel under like pressure to the fuel controller B on one side of the diaphragm 11 through the pipe K and the port 7.

A valve 8 in the fuel controller B is normally seated by the spring 9, closing the port 10 to the pipe L but when fuel under pressure is admitted through pipe K and port 7, the pressure operating on the diaphragm 11 to which the valve is connected, overcomes the action of the spring 9 and unseats the valve 8 to admit fuel to the burner of the generator G through the port 10 and pipe L.

When the fuel is ignited in the combustion chamber in the generator G, which may be accomplished by the pilot tube or burner T, the water in the generator is heated and evaporated, producing steam under pressure. This steam pressure is at all times admitted through the pipe D to the cylinder 20 in the regulator R and operates on the piston 12, which latter is connected to and moves with the pistons 3 and 13.

The relative areas of piston 12 and piston 3 are so proportioned that at any predetermined relation between the steam pressure in the cylinder 20 and the air pressure in the cylinder 2, the total pressure on the two pistons 12 and 3 practicaly balance each other. When the steam pressure in the generator G rises above the normal amount required to maintain this balance, the pressure in the cylinder 20 forces the piston 12 in one direction, carrying with it the piston 3 against the air pressure in the cylinder 2, and moving the piston 13 to a position to close the communication between the port 4 and the atmosphere through the cylinder 5 and the port 6. This movement of the piston 13 brings the annular chamber 14 at the same time into communication with cylinder 2 and the air pressure from port 1 of cylinder 2, is then admitted into the fuel controller B through pipe E on the other side of the diaphragm to balance the fuel pressure on the diaphragm 11. When the fuel pressure is thus balanced the spring 9 then forces the valve 8 to its seat, closing the port 10 and automaticaly cutting off the supply of fuel to the heater of the generator G.

Any suitable means may be provided for rendering the feed pump inoperative but a simple and effective means for accomplishing this end will now be described.

Simultaneously with the stoppage of the supply of fuel to the heater of the generator G the air pressure is admitted to the one end of the water controller C through the pipe E′ and on one side of the diaphragm 15 therein. The diaphragm 15 in the water controller C is normaly held in an inoperative position by the spring 16, but when the air pressure is admitted to the water controller C back of the diaphragm, the air pressure acting on the diaphragm 15 overcomes the spring 16 and forces the rod 17 which is connected to be operated by the diaphragm, into engagement with a suction valve 18 in the feed pump P to unseat the valve and render the pump inoperative, thereby stopping the supply of water to the generator G. When the generator G is thus deprived of its supply of fuel and water, the steam pressure therein will gradually be reduced with more or less rapidity, depending upon the demand. When the steam pressure falls below the amount required to maintain on the piston 12 in the regulator R a balance with the air pressure on the piston 3, the pistons 3 and 12 will be moved or shifted by the air pressure against the steam pressure, and the piston 13 will be carried beyond the annular chamber 14 to the position shown in full lines in the drawing. The port 4 will be thus again placed in communication with the atmosphere through the cylinder 5 and the port 6 and one side of the diaphragm 11 in the fuel controller B will be relieved of the air pressure which latter

escapes through the pipe E and the port 4. The pressure of the fuel on the other side of the diaphragm 11 then overcomes the action of the spring 9, which seats the valve 8 thereby compressing the spring to raise the valve 8, to again admit a supply of fuel through the port 10 and the pipe L to the burner of the generator G where it is ignited by the pilot burner T, maintained constantly lighted for that purpose. Simultaneously one side of the diaphragm 15 in the water controller C will be relieved of the air pressure, which latter escapes through the pipe E′, and ports 4 and 6. The spring 16 then forces the rod 17 out of engagement with the suction valve 18 allowing the latter to be seated by the action of the controlling spring 19 permitting the feed pump P to again become operative and supply water to the generator G. An ordinary check valve 40 is provided in the pump P.

From the above it will be seen that the regulator R automatically maintains practically a constant steam pressure in the generator G, the relation between the amount of air pressure in the air tank A and the amount of steam pressure in the generator G being determined by the proportional areas of the pistons 3 and the piston 12 in the regulator R, a slight variation in the steam pressure carried in the generator G up or down being sufficient to automatically operate the mechanism and reestablish the normal steam pressure. It will also be seen that the normal pressure to be maintained in the generator G may be varied at the will of the operator by adjusting the safety valve V on the air tank A, any change in the amount of pressure carried in the air tank A automatically effecting a relative change in the amount of steam pressure carried in the generator G. There are occasions, however, in the ordinary use of a steam carriage as in ascending heavy grades, or in the case of a steam carriage used for trucking when it is heavily loaded it becomes necessary for the engine to supply an increased amount of power. At such times the speed of the engine is gradually reduced and as the feed pump is ordinarly driven by the engine, the speed of the feed pump is also reduced with the result that the amount of water supplied to the generator is decreased in like proportion. At such times it is desirable that an increased supply of feed water and fuel shall at once and automatically be supplied to the generator G. In order to accomplish this result there is provided a second regulator R^2, which is similar in construction to the regulator R, and is adapted to regulate the supply of the additional feed water and fuel to the generator G. This regulator R^2 comprises a cylinder 22, in which moves a piston 23. A cylinder 25 similar in construction to the cylinder 5, is arranged to communicate with the cylinder 22, and a piston 33 moves within the cylinder 25 and is connected for movement with the piston 23. The cylinder 25 is provided with an outlet 26 to the atmosphere, and an annular chamber 34 which has communication with the cylinder 25. This annular chamber 34 is located beyond the cylinder 22, so that the piston 33 may assume a position (as shown in full lines in the drawing) to stand between the cylinder 22 and the chamber 34, to cut off communication between the chamber 34 and the cylinder 22 and establish communication with the chamber and the cylinder 25. The piston 33 is also adapted to assume the position shown in dotted lines so as to reëstablish communication between the chamber 34 and the cylinder 22 and to cut off communication between the chamber 34 and the atmosphere through the port 26. The cylinder 22 is also provided with an inlet port 21, corresponding with the port 1 of the regulator R, and which port 21 has communication with the supply pipes O and O^2. A port 24 is also provided in the regulator R^2, which is similar to the port 4 of the regulator R, and has communication with the chamber 34 and the pipes H and H′. The pipe H has communication with the water controller C^2 of the pump P^2, and the pipe H′ has communication with the fuel controller B^2.

Communicating with the cylinder 22 and on the side of the piston 23 opposite to that on which the cylinder 25 is located, is a cylinder 30, similar to the cylinder 20 of the regulator R, but is preferably slightly larger than the cylinder 20, so that the piston 32 which moves in the cylinder 30 will be of about ten per cent. greater area than the piston 12. This piston 32 is connected to move with the piston 23, so that when one of the pistons is moved all three of the pistons 33, 23 and 32 are simultaneously moved. The cylinder 30 has communication with the steam supply pipe D, which supplies the cylinder 20, through the medium of a connection D^2, and as the piston 32 of the regulator R^2 is of a larger area than the piston 12 of the regulator R, a greater pressure will be required to move the piston 12 than to move the piston 32, as will be hereinafter set forth.

The feed pump P^2 is of the ordinary construction, preferably of the same construction as the pump P, and may be operated in any desired or suitable manner for forcing the supply of additional water to the generator G through the pipe N^2, and the pipe N.

The water controller C^2 for the extra supply of feed water is of a construction similar to the controller C, and is provided with a diaphragm 35 connected to which is a rod 37, which rod is adapted to be moved by the diaphragm in one direction to engage a suc-

tion valve 38 and unseat the same against the tension of a controlling spring 39, as will be set forth. A check valve 42 similar to the check valve 40 may be provided within the pump P^2.

The fuel controller B^2 for the extra supply of fuel is of a construction similar to the fuel controller B and is provided with the valve 48 which is normally seated by the spring 49 closing the port 50 to the pipe L^2, but when fuel under pressure is admitted through the pipe K^2, and the port 47, the pressure operating on the diaphragm 51 to which the valve 48 is connected overcomes the action of the spring 49 and unseats the valve 48 to admit the additional supply of fuel to the burner of the generator G through the port 50 and the pipe L^2.

The pressure from the air tank A is carried through the pipes O and O^2 to the regulator R^2 where it is admitted by the port 21 to the cylinder 22 moving the pistons 23 and 33 to open the port 24, through the annular chamber 34 to the atmosphere through the cylinder 25 and the port 26. The cylinder 22 on the side of the piston 23 opposite to the side on which the cylinder 25 is located is open to the atmosphere at all times through the ports X^2 in order that the movement of the piston 23 will not be retarded.

When the fuel is ignited in the combustion chamber in the generator G, the water in the generator is heated and evaporated, producing steam under pressure. This steam pressure is at all times admitted through the pipes D and D^2 to the cylinder 30, in the regulator R^2 and operates on the piston 32 to move the pistons 23 and 33 in one direction.

The relative areas of piston 32 and piston 23 are so proportioned that at any predetermined relation between the steam pressure in the cylinder 30 and the air pressure in the cylinder 22, the total pressure on the two pistons 32 and 23 practically balance each other. When the steam pressure in the generator G rises above the normal amount required to maintain this balance, the pressure in the cylinder 30 moves the piston 32, carrying with it the piston 23 against the air pressure in the cylinder 22 and moving the piston 33 to a position beyond the annular chamber 34 to the position shown in dotted lines in the drawing, thus closing the communication between the port 24 and the atmosphere through the cylinder 25 and the port 26. The annular chamber 34 is at the same time brought in communication with cylinder 22 and the air pressure from port 21 of the cylinder 22 is then admitted to the water controller C^2 through the pipe H to act upon the diaphragm 35 therein. This diaphragm 35 is normally held in an inoperative position by the spring 36, but when the air pressure is admitted into the water controller C^2, it will act upon the diaphragm 35 to overcome the spring 36 and force the rod 37 into engagement with the suction valve 38 in the feed pump P^2 to unseat the same against the tension of the spring 39 to render the pump inoperative, in which condition it remains as long at the feed pump P is able to supply sufficient water to the generator G to produce all the steam required for the operation of the engine. When, however, the steam pressure in the generator G falls below the amount required to maintain on the piston 32 in the regulator R^2 a balance with the air pressure on the piston 23, the piston 23 and the piston 32 will be shifted by the air pressure against the steam pressure and the piston 33 will be carried beyond the annular chamber 34 to the position shown in full lines in the drawing. The port 24 is thus again placed in communication with the atmosphere through the cylinder 25 and the port 26. The diaphragm 35 in the water controller C^2 will then be relieved of the air pressure which escapes through the pipe H and the ports 24 and 26. The spring 36 then acts upon the rod 37 to move the same out of engagement with the valve 38 to permit the latter to be seated by the action of the spring 39 and the feed pump P^2 becomes operative and supplies water to the generator G. At the same time that the air pressure is admitted to the water controller C^2 through the pipe H, the air pressure is also admitted to the fuel controller B^2 through the pipe H′ on the other side of the diaphragm 51 to balance the fuel pressure on that diaphragm. When the fuel pressure is thus balanced the spring 49 then forces the valve 48 to its seat, closing the port 50 and cutting off the supply of fuel through the pipe L^2. This condition continues until such time as the steam pressure in the generator G falls below the amount required to maintain on the piston 32 in the regulator R^2 a balance with the air pressure on the piston 23. The pistons 23 and 32 will then be shifted by the air pressure against the steam pressure as has been previously described and the diaphragm 51 in the fuel controller B^2 will be relieved of the air pressure which escapes through the pipe H′ and the ports 24 and 26. The fuel pressure operating on the diaphragm 51 then overcomes the action of the spring 49 and unseats the valve 48 to again admit the additional supply of fuel through the pipe L^2. This control of the operation of the valve 48 and of the feed pump P^2 by the action of the regulator R^2 is in all respects similar to the control of the operation of the feed pump P and the valve 8 by the regulator R, but in order to maintain the feed pump

P^2 normally in an inoperative condition and to insure that it shall be brought into operation at such times only as the amount of water supplied to the generator G by the feed pump P is not sufficient to produce the amount of steam required by the engine and at the same time to insure that the valve 48 shall remain closed except under like conditions, and when an increased amount of fuel is required to evaporate the additional supply of feed water then being delivered, the cylinder 30 and the piston 32 in the regulator R^2 are made with a diameter about five per cent. greater than the diameter of the cylinder 20 and the piston 12 in the regulator R, although of course this proportion may be varied as desired; all other parts and dimensions in the two regulators being made alike and interchangeable.

The operation of the apparatus is as follows: As shown above, when the steam pressure in the cylinder 30 in regulator R^2 rises above the amount required to maintain the balance on the piston 32 with the air pressure on the piston 23, the pistons 32 and 23 are shifted in a direction to move the piston 33 to a position to admit the air pressure to the water controller through the pipe H, and to the fuel controller B^2 through the pipe H'. The diaphragm 35 in the water controller C^2 then shifts the rod 37 to open the suction valve 38 and render the feed pump P^2 inoperative, and simultaneously the diaphragm in the fuel controller B^2 is rendered inoperative, the pressure on the two sides being made equal and the spring 49 then forces the valve 48 to the seat and stopping the additional supply of fuel. As, however, the area of the piston 12 in the regulator R is about ten per cent. less than the area of the piston 32 in the regulator R^2, a higher steam pressure is required on the piston 12 in the regulator R to overcome the air pressure on piston 3 than is necessary on piston 32 in the regulator R^2 to overcome the air pressure on piston 23, and consequently the suction valve 18 in the feed pump P is not moved from its normal position, but is free to operate, and the feed pump P therefore continues to supply water to the generator G, and in like manner the fuel controller B continues to admit the normal supply of fuel to the generator through the port 10. For as long a time as the water supplied by the feed pump P to the generator G and the fuel supplied through the port 10 are sufficient to produce all the steam required by the engine, the steam pressure on the piston 32 in the regulator R^2 will be maintained at a point sufficient to overcome the air pressure on piston 23, and as before described, the air pressure will then continue to be admitted through the pipe H to the diaphragm 35 in the water controller C^2 and the rod 37 will thus be held in a position to keep the suction valve 38 constantly from its seat to maintain the feed pump P^2 inoperative and in like manner the air pressure will be admitted through the pipe H' to the diaphragm 51 of the fuel controller B^2 and the valve 48 will be seated to close the port 50 and prevent any fuel passing through the pipe L^2 to the burner of the generator. When, however, the amount of water supplied by the feed pump P and the fuel supplied through the pipe K are insufficient to produce the amount of steam required for the operation of the engine, the steam pressure will gradually fall until it reaches a point when the air pressure on the piston 23 in the regulator R^2 overcomes the steam pressure on the piston 32. The piston 32 is then forced in a direction to move the piston 33 beyond the annular chamber 34 to the position shown in full lines in the drawing. The diaphragm 35 in the water controller C^2 is thus relieved of the air pressure which escapes through the pipe H. The suction valve 38 in the feed pump P^2 is then again seated by the spring 39 and the feed pump P^2 commences to supply the additional water to the generator G and simultaneously the diaphragm 51 in the fuel controller B^2 is relieved of the air pressure which escapes through the pipe H', the pressure of the fuel then raises the valve 48 and the additional fuel will pass through the pipe L^2 to the burner of the generator.

The port 10 in the fuel controller B and the port 50 in the fuel controller B^2 are each made of the proper size to supply the amount of fuel required to evaporate the water supplied respectively by the two feed pumps P and P^2. The two pump feeds P and P^2 are made of such capacity that the amount of water supplied to the generator G when both pumps are in operation will produce more steam than can be used in the engine when working at its full power. Consequently, whenever both pumps are delivering water to the generator G, the steam pressure in the generator will gradually rise until it reaches a point where, through the operation of regulator R^2 as before described, the feed pump P^2 is rendered inoperative and the supply of fuel through the port 50 is stopped and remains so until more steam is required to operate the engine than can be produced from the water supplied by the feed pump P. The feed pump P^2, as has been before described, is then again brought into operation and the supply of fuel through the port 50 and the pipe L^2 is then again started by the regulator R^2, which thus automatically controls the feed pump P^2 and the relative supply of fuel, placing them in operation whenever additional fuel and water are required and cut-

ting off the additional supply whenever the fuel controller B and the feed pump P are able to supply all the fuel and water required for the operation of the engine.

While in the present exemplification of the invention there is shown and described the preferred manner for automatically and simultaneously controlling the fuel and water supply, it is to be understood that various changes may be made in the construction, operation and arrangement of the several parts without departing from the spirit of this invention.

What I claim as new is—

1. In an apparatus of the character described, the combination with a vapor generator, of a fluid feed, a fuel feed, a plurality of regulators for controlling the said feeds, means whereby one of the regulators will control a supply of fuel and a supply of fluid, and means whereby the other regulator will control an additional supply of the fluid and the fuel.

2. In an apparatus of the character described, the combination with a vapor generator, of a fluid feed, a fuel feed, a plurality of regulators, means whereby one of the regulators will cause the fluid and fuel to be admitted to the generator at one pressure of steam in the generator, and means whereby the other regulator will cause an additional supply of fluid and fuel to be admitted to the generator at a different pressure in the generator.

3. In an apparatus of the character described, the combination with a vapor generator, of a fluid feed, a fuel feed, a plurality of regulators, each of said regulators controlling a supply of fluid and a supply of fuel, said regulators being adapted to be acted upon by the generator pressure, and means whereby each of the regulators will be actuated to control their respective feeds by a degree of pressure different from the degree of pressure necessary to actuate the other regulators.

4. In an apparatus of the character described, the combination with a vapor generator, of a fluid feed, a fuel feed, a plurality of regulators each of said regulators being adapted to control a supply of fluid and fuel, means whereby said regulators will be acted upon by the generator pressure, means for exerting an opposing pressure upon said regulators, means whereby one of the regulators will start and stop a supply of fluid and fuel simultaneously when a predetermined pressure in the generator is reached, and means whereby the other regulator will start and stop an additional supply of fluid and fuel when a different predetermined pressure is obtained.

5. In an apparatus of the character described, the combination with a vapor generator, of a fluid feed, a fuel feed, a plurality of regulators, each of said regulators being adapted to control a supply of fluid and fuel, means whereby said regulators will be acted upon by the generator pressure, means for exerting air pressure upon said regulators, means whereby one of the regulators will start and stop a supply of fluid and fuel simultaneously when a predetermined pressure in the generator is reached, and means whereby the other regulator will start and stop an additional supply of fluid and fuel when a different predetermined pressure is obtained.

6. In an apparatus of the character described, the combination with a vapor generator, of a fluid feed, a fuel feed, a plurality of regulators, each of said regulators separately controlling a supply of fluid and a supply of fuel, means whereby the generator pressure will act upon the regulators, means for exerting an opposing air pressure on the regulators, and means whereby each of the regulators will become operative at a generator pressure differing from that necessary to operate the other regulators.

7. In an apparatus of the class described, the combination with a vapor generator, of a fluid feed, a fuel feed, a plurality of regulators for controlling the said feeds, said regulators being adapted to cause different supplies of fuel and fluid to the generator, and means whereby said regulators may be actuated at different pressures in the generator to control the supplies.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, on this seventh day of January A. D. 1909.

CHAS. C. WORTHINGTON.

Witnesses:
M. R. WORTHINGTON,
C. W. COLLIERE.