April 29, 1930. J. T. DALCHER 1,756,423

PRESSURE FLUID GENERATOR

Filed June 23, 1925 2 Sheets-Sheet 1

Fig. 1.

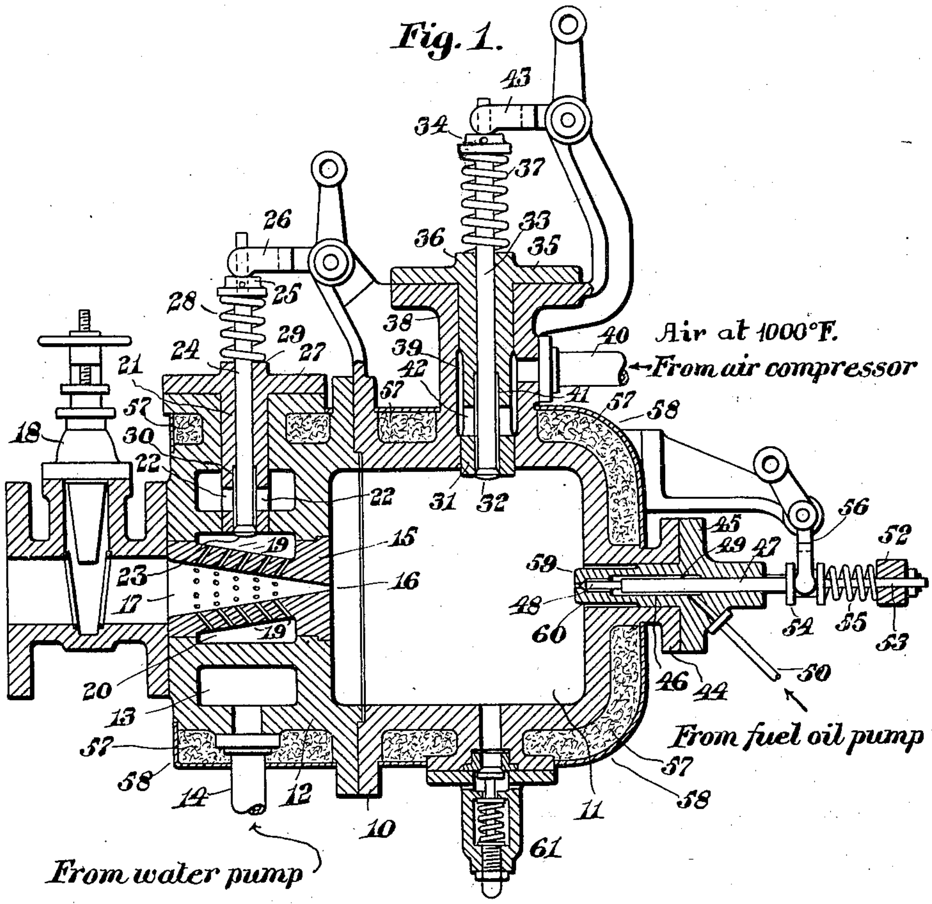

Fig. 2.

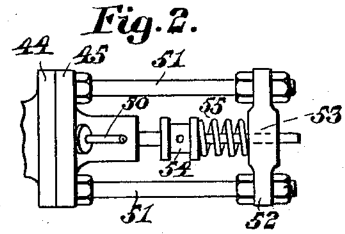

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Fig. 3.

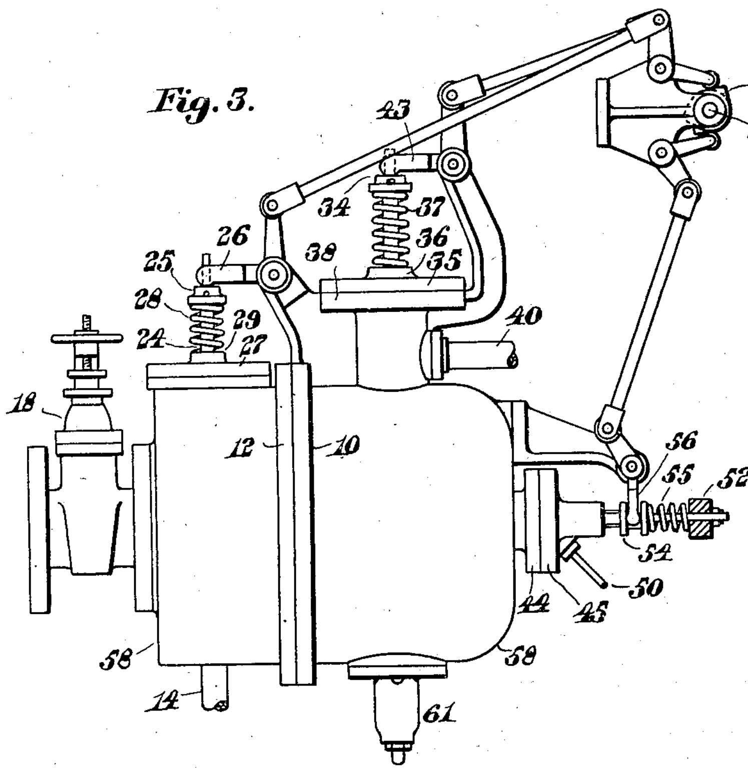


Fig. 4.

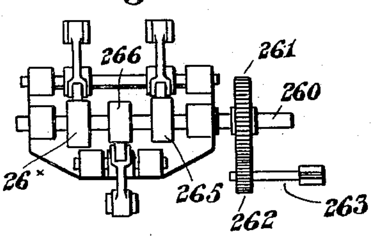
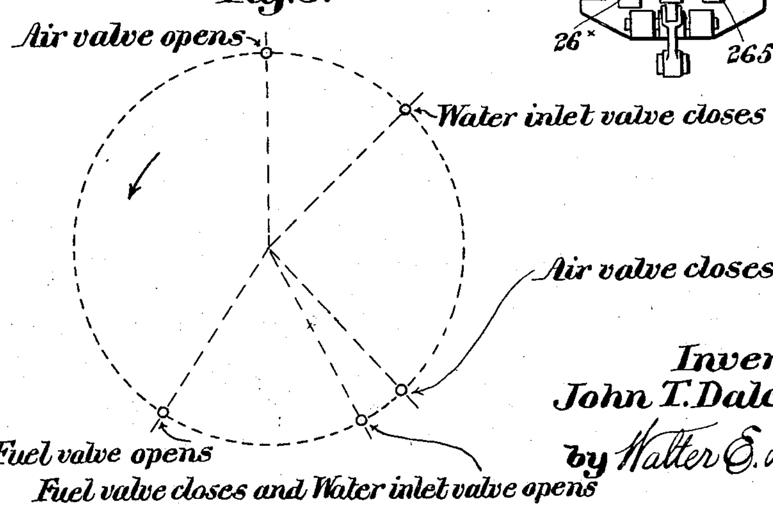


Fig. 5.



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UNITED STATES PATENT OFFICE

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PRESSURE-FLUID GENERATOR

Application filed June 23, 1925. Serial No. 39,050.

This invention relates to pressure fluid generators and has for its object the production of means whereby steam may be produced direct from the fuel without the use of boilers.

The invention consists in certain novel features of construction and arrangement of parts which will be understood readily by reference to the description of the drawings and to the claims to be hereinafter given.

This invention is a continuation in part of application No. 662,569, filed September 13, 1923.

For the purpose of illustrating the invention, one preferred form thereof is shown in the drawings, this form having been found to give satisfactory and reliable results, although it is to be understood that the various instrumentalities of which the invention consists can be variously arranged and organized, and that the invention is not limited to the precise arrangement and organization of the instrumentalities as herein shown and described, except as required by the scope of the appended claims.

Of the drawings

Figure 1 represents a vertical section of an apparatus embodying the principles of the present invention.

Figure 2 represents an inverted plan of the right hand portion thereof.

Figure 3 represents an elevation of the apparatus showing the cam mechanism for actuating the various valves.

Figure 4 represents an elevation of the cam mechanism, and

Figure 5 represents a diagram showing the time for opening and closing the various valves of the apparatus.

Similar characters indicate like parts throughout the several figures of the drawings.

In the drawings, 10 is a casing having a combustion chamber 11 therein, said casing 10 being cup-shaped with its open end closed by a cover 12.

The cover 12 is provided with an annular water chamber 13 to which water is admitted through the inlet pipe 14 from any suitable source.

Centrally disposed in the cover 12 is a nozzle 15, the bore of which is cone-shaped with its smaller end 16 communicating with the combustion chamber 11, while the larger end 17 communicates with the stop valve 18 for the discharge of the steam generated, it having been conclusively proved by repeated experiments that a certain evaporation may be obtained with no residue traceable.

The wall of the nozzle 15 intermediate its ends is provided with a plurality of holes 19 extending therethrough, said holes being inclined inwardly toward the larger end 17 of the bore of said nozzle.

These holes 19 communicate with a water jacket 20, from which extends the tubular member 21 having ports 22 therein always in communication with the water chamber 13.

The inner end of the tubular member 21 is provided with a seat for the valve 23, the stem 24 of which extends through said tubular member 21 and has secured to its outer end a collar 25, with which coacts a lever 26 to move the valve 23 from its seat.

The lever 26 is moved about its fulcrum by a cam 26ˣ secured to and revoluble with a cam shaft 260 having a gear 261 mounted thereon and meshing with a pinion 262 secured to a shaft 263 which may be driven by a separate motor.

The tubular member 21 has a flange 27 on its outer end, providing a means for securing said tubular member 21 to the cover 12.

The valve 23 is retained normally on its seat by a spring 28 surrounding the valve stem 24 and positioned between the collar 25 and a hub 29 projecting upwardly from the flange 27.

It is obvious that when the lever 26 is

moved downwardly by the cam 26× or other suitable mechanism, the valve 23 will be opened and water from the chamber 13 will be admitted to the water jacket 20, and then through the holes 19 into the bore of the nozzle 15.

Surrounding the valve stem 24 from the ports 22 to the inner end of the tubular member 21 is an annular space 30, whereby the water admitted through the ports 22 may flow freely into the water jacket 20 when the valve 23 is in open position.

The casing 10 also has a tubular member 31 extending through the wall thereof, the inner end of which is provided with a seat for the valve 32, which has a valve stem 33 extending through said tubular member 31 with a collar 34 secured to its outer end.

This tubular member 31 is provided with a flange 35 on its outer end, providing a means whereby the member 31 may be secured in position in any well known manner.

Between a hub 36 projecting upwardly from the flange 35 and the collar 34, and surrounding the valve stem 33 is a spring 37 which, under normal conditions, retains the valve 32 upon its seat.

The tubular member 31 is disposed within a tubular boss 38 on the casing 10, and between said member 31 and the inner wall of the boss 38 is an annular space 39 to which heated air under compression is admitted through the pipe 40 from any suitable source of supply.

Surrounding the valve stem 33 within the tubular member 31 is an annular space 41 extending to the inner end of the member 31 and communicating by means of the ports 42 with the space 39.

By means of this construction, the air may pass freely from the supply pipe 40 into the combustion chamber 10 whenever the valve 32 is in open position.

The valve 32 is opened by means of the lever 43 coacting with the collar 34, said lever being actuated by a cam or suitable mechanism. As the means for actuating the various valve levers form no part of the present invention, it is believed that it is not necessary to fully illustrate the same.

In Fig. 4, however, is shown a cam 265 which is adapted to move said lever 43 about its fulcrum to regulate the movement of the valve 32, said cam 265 being secured to and revoluble with the cam shaft 260.

The casing 10 has a flanged hub 44 in alinement with the nozzle 15 and to this hub 44 is secured the flange 45 of a tubular member 46, the inner end of which extends through the wall of casing 10, while the outer end thereof forms a bearing for a reciprocating spindle 47 having a needle valve 48 on its inner end.

This valve 48 has a seat therefor at the inner end of the bore of the tubular member 46, said bore for some distance being of greater diameter than the spindle 47, thereby leaving an annular space 49 to which fuel is admitted through the supply pipe 50.

From the flange 45 extend two rods 51, the opposite ends of which are connected by a bar 52 having therein a bearing 53 through which the spindle 47 is adapted to reciprocate.

This spindle 47 has secured thereto a collar 54, between which and said bar 52 is a spring 55 surrounding said spindle 47.

The spring 55 retains the valve 48 on its seat under normal conditions so that no fuel can be admitted to the combustion chamber 11.

When it is desired to admit fuel to the combustion chamber 11, the valve 48 is moved into open position by the lever 56 coacting with the flanged collar 54, said lever 56 being actuated by a cam 266 secured to and revoluble with the shaft 260.

The cams 26×, 265 and 266 are installed upon the cam shaft 260 in such a manner as to time the opening and closing of the valves 23, 32 and 48 in each cycle as indicated in the diagram Fig. 5.

The walls of the combustion chamber casing 10 and the cover 12 are covered with a lagging 57 of some non-conductor of heat, such as magnesia, asbestos, or similar material, said lagging being enclosed within a covering 58 of sheet metal.

The inner end 59 of the valve body 46 is surrounded by an annular space 60 communicating with the combustion chamber 11, thereby permitting the heat generated in the chamber 11 to surround said inner end 59 and superheat the fuel within the valve body 46 prior to its discharge into the combustion chamber.

The air admitted to the combustion chamber 11 is first compressed, and has a corresponding final temperature of about 1000 degrees Fahrenheit.

Various forms of fuel may be used, as for instance crude or heavy oils, and these oils are subjected to a pressure of from 4,000 lbs. to 8,000 lbs. per square inch, or in other words, a pressure greatly in excess of that of the air being used.

It will be noted that Diesel engines of the solid injection type are designed for a maximum fuel oil pressure of 10,000 pounds per square inch, and under ordinary conditions the fuel oil pressure varies between 4,000 and 6,000 pounds per square inch. In order to sustain such high pressures the pipes are made of extraordinary heavy seamless drawn steel tubing with corresponding fittings of forged steel.

When this fuel is admitted to the combustion chamber in the form of vapor or mist, it comes into intimate contact with the heated compressed air, which will spontaneously ignite the fuel, and this mixture will continue to burn at a constant pressure as long as the fuel is admitted to the combustion chamber 11.

The exhaust from the nozzle 15 passes through the stop valve 18 into a pipe (not shown) through which it may be conveyed to any desired point.

The combustion chamber proper is provided with a relief or sentinel valve 61 which operates as follows:

In starting the mechanism the stop valve 18 is closed so as to maintain a constant high pressure to initiate combustion.

As soon as the proper heat has been developed within the combustion chamber, the pressure therein is increased which causes the relief valve 61 to open, showing the operator that normal conditions have been established, that is, conditions for proper combustion have been attained, that heat has been generated within the combustion chamber to preheat the incoming air and fuel oil to such a degree as to insure proper ignition.

The stop valve 18 should at this time be opened so that the apparatus may function as elsewhere described herein.

The safety valve 61 is set to actuate at a predetermined pressure, conforming to the pressure which must be reached under the particular conditions of combustion it is desired to maintain.

The operation is different from that of an explosion engine inasmuch as no spark plugs or hot plates are used, and the ignition of the fuel is due to the fact that the mist of highly compressed fuel being admitted to the chamber is mixed with highly compressed air heated above the burning point of the oil.

It is desirable to utilize all the heat available that is developed in the combustion chamber due to the burning fuel, and therefore the walls of the casing and cover are provided with a lagging 57 which is non-conductive of heat.

As a consequence, the radiation of heat through the casing walls is reduced to a minimum.

No water jackets are used on the combustion chamber casing, and there is no opportunity for any of the heat being carried away in cooling water.

The consequence is that the efficiency of the apparatus is greatly increased over any apparatus of a similar character using cooling water in the cylinder jackets and pistons, it having been found by experiment that the amount of heat carried away by this cooling water is usually about 30% of the total heat per working stroke, in a conventional internal combustion or Diesel engine.

It must be understood that whatever heat is given up by the fuel burning process to the walls of the combustion chamber, interior valve bodies, etc., is to a great extent regained by heating the compressed air being admitted to the combustion chamber prior to the admission or injection of the fuel oil.

In other words, the walls of the combustion chamber, valve bodies, etc., are cooled from the interior and the heat given up by these elements between combustion cycles is utilized to increase the temperature of the compressed air, thereby increasing the thermal efficiency of the cycle.

By this method, energy is developed in the combustion chamber as individual pulsations or cycles, similar to a reciprocation motion of an internal combustion engine or Diesel engine.

This result is obtained as follows:

(1st) Compressed air at practically a constant pressure is admitted to the combustion chamber and this air is then highly heated by the heat given up from the interior of the combustion chamber walls.

(2nd) The fuel oil is injected into the combustion chamber at a pressure considerably above that of the heated air through a valve designed to discharge the oil into the compressed air in the form of a fine spray, vapor or mist, at predetermined intervals corresponding to the admission of the compressed air.

(3rd) The fuel thus admitted to the combustion chamber will ignite and burn spontaneously as soon as it comes into contact with the heated compressed air, without explosion, and will continue to burn steadily in the combustion chamber until the fuel valve is closed and the supply of fuel stopped.

(4th) The product of the combustion is discharged from the combustion chamber into a nozzle which is always in communication with the combustion chamber.

(5th) The valve 32 admitting compressed air into the combustion chamber 11 is closed somewhat later than the fuel valve 48 is closed, so as to scavenge the combustion chamber and discharge nozzle 15 of any residual vapours which may remain therein and be detrimental to or cause premature combustion when the next charge of heated compressed air is admitted into the combustion chamber.

The fuel oil valve 48 is in direct alinement with the nozzle 15 and therefore all energy developed in the combustion chamber will be directed to flow through the nozzle 15 in the form of hot gases. In passing through the nozzle 15, these hot gases will be mixed with hot water, which is injected under pressure at intervals corresponding to the periods of combustion in the combustion chamber, in such a manner as to convert the whole energy into steam.

This steam will be saturated or superheated, depending on the amount of water being injected and also on the particular design of nozzle being used.

The final energy—steam—is transferred into useful work by admitting it to a prime mover such as a turbine, or other mechanical device, either rotary or reciprocating.

By referring to the drawing, it will be noted that the nozzle 15 is entirely surrounded by a water jacket 20, from which a plurality of small openings 19 extend into the bore of the nozzle 15, these openings 19 being so arranged as to facilitate the flow of water toward the axis of said nozzle.

The nozzle 15 is so designed as to partly convert the pressure of the gases gradually into velocity.

The hot gases flow through the nozzle 15 with such velocity as to create a suction effect in the openings 19, and thereby draw the water into the nozzle, thus stimulating the mixture of the hot gases and water similar to the action of an air injector and causing the energy of the hot gases caused by the combustion to be changed into steam.

In order to render the mixing of the hot gases and water more perfect, the water jacket 20 surrounding the nozzle 15 is always kept under high pressure, by being connected with a suitable pressure pump which may be of any well known construction, and consequently does not need to be illustrated.

The valve 23 admitting water to the nozzle water jacket 20 is controlled in such a manner as to open and close at the proper time, so as to synchronize with the periods of combustion in the combustion chamber.

The water jacket 20 is in the cover 12 of the combustion chamber and is therefore heated by the heat radiating through the walls of said cover from the combustion chamber.

The heat in the walls of the water jacket 20 and water chamber 13 will, in turn, be transmitted to the water therein and heat the same before said water comes into direct contact with the hot gases, thereby increasing the efficiency of the steam generator.

The three valves for air, oil, and water may be driven from the prime mover or from an independent motor through a system of cams and levers similar to the conventional design as used on various types of internal combustion engines. Such a system is illustrated in diagram in Figs. 3 and 4.

In order to better understand the invention, it must be understood that the cycle described is that of a "super Diesel cycle" making use of the full amount of heat developed within the combustion chamber which heat is converted into mechanical energy, thereby increasing the efficiency of the cycle as a whole.

As a consequence the temperatures and pressures will be higher than those of the ordinary Diesel cycle.

The efficiency of the cycle will be increased on the basis of the fundamental law of thermodynamics and as expressed by the formula

$$E=\frac{T^1-T^2}{T^1}$$

T^1 = absolute temperature received.
T^2 = absolute temperature rejected.

In other words, the underlying principle involved in the present invention calls for a working condition within a higher degree of temperature than usual, as no heat is being carried away by cooling water and the cycle will approach the efficiency of a perfect heat engine to a higher degree than the cycle of the Diesel engine now in common use.

Having thus described my invention, I claim:

1. In a device of the class described, a combustion chamber; means for admitting air under a predetermined pressure to said chamber; means for subsequently admitting fuel oil to said chamber; a perforated nozzle communicating with said combustion chamber; a water jacket surrounding said nozzle; a water chamber surrounding said water jacket; a tubular member in the walls of said water jacket and water chamber and communicating at its inner end with said water jacket, and through ports with said water chamber; and a valve in said tubular member adapted to close the inner end thereof.

2. In a device of the class described, a combustion chamber; means for admitting air under a predetermined pressure to said chamber; means for subsequently admitting fuel oil to said chamber; a perforated nozzle communicating with said combustion chamber; a water jacket surrounding said nozzle; a water chamber surrounding said water jacket; a tubular member in the walls of said water jacket and water chamber and communicating at its inner end with said water jacket and through ports with said water chamber; and a spring pressed valve in said tubular member adapted to close the inner end thereof.

3. In a device of the class described, the combination of a combustion chamber, means for admitting highly heated compressed air into said chamber, means for admitting fuel-oil into said chamber, a perforated nozzle communicating with the interior of said chamber, a water-jacket around said nozzle and in communication with the perforations thereof, a water-chamber, and a valve operable to establish and interrupt a communication between said water-jacket and water-chamber.

4. In a device of the character described, the combination of a combustion chamber, means for admitting highly heated compressed air into said chamber, means for admitting atomized fuel into said chamber, a perforated nozzle communicating with the interior of said chamber, a water-jacket around said nozzle and in communication with the

perforations thereof, a water-chamber around said water-jacket, a tubular member communicating with the interiors of said water-jacket and water-chamber, and a valve in said tubular member and operable to open and close the latter for establishing and interrupting a communication between said water-jacket and water chamber.

Signed by me at Bayonne, N. J., this 18th day of June, 1925.

JOHN T. DALCHER.