Oct. 27, 1931. R. PERRIN 1,828,784

PRESSURE FLUID GENERATOR

Filed Aug. 16, 1927 2 Sheets-Sheet 1

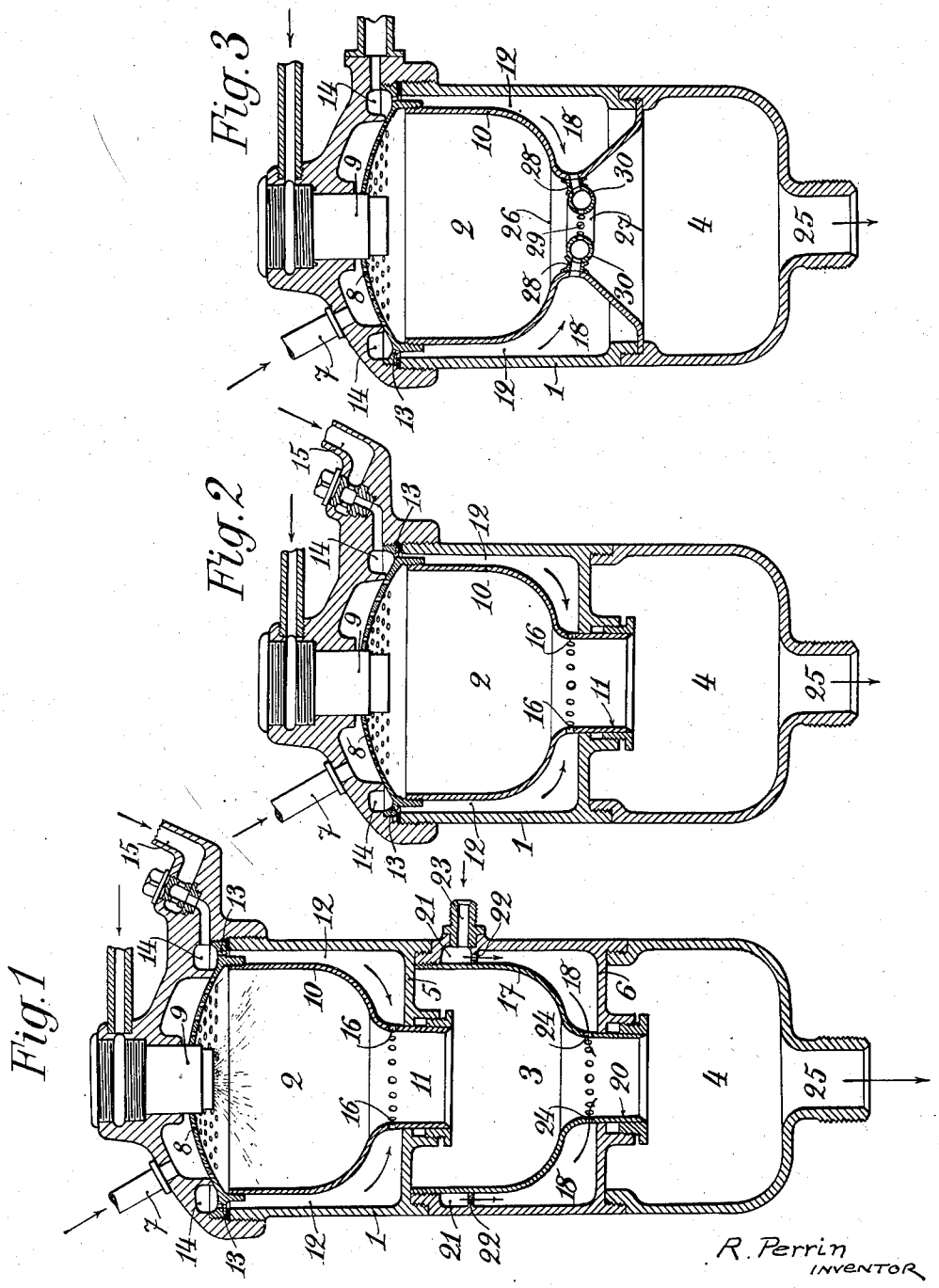

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Fig. 5

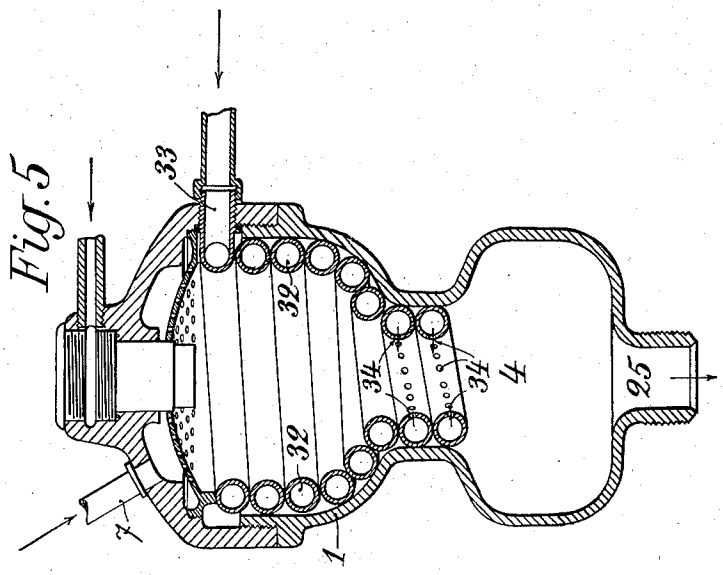
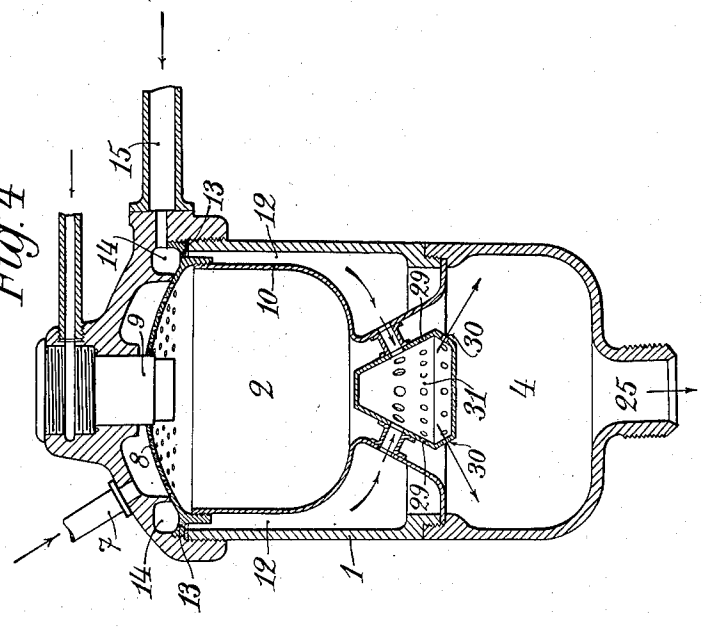


Fig. 4



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UNITED STATES PATENT OFFICE

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PRESSURE FLUID GENERATOR

Application filed August 16, 1927, Serial No. 213,403, and in France November 28, 1923.

The present invention relates to a gas generator producing power gas under pressure for the supply of the engines used in torpedoes of the modern types, the said generator being suitably arranged and supplied with a comburant (oxygen or a fluid containing oxygen), fuel and optionally with a cooling liquid in a particular manner whereby the consumption of the comburant for a given amount of work will be reduced.

The said gas generator is of the type in which the power fluid under pressure is produced by the combustion reaction of a gaseous comburant such as air or oxygen with a liquid fuel, a cooling fluid being further introduced into the gases of combustion whereby they will be cooled to a point at which they will offer no damage to the engine, while permitting the use of the comburant as completely as possible.

In the said invention, suitable fuel feeding devices are placed at successive points upon the path of the gases, between the comburant inlet and the discharge end of the generator. Due to this special method of feeding the fuel, the whole of the comburant supplied to the generator will enter into the combustion reaction, and this offers an advantage in the case of torpedoes, since the consumption of comburant for a given amount of work is reduced to a minimum, which comburant, being in the gaseous state, requires the use of containers of an excessive weight. This advantage results in particular from the fact that it becomes easier to regulate the successive temperatures to which the reacting bodies are heated, and on the other hand this will further the construction of the apparatus.

It has already been proposed to supply the combustion chamber with a mixture of comburant with an excess of fuel, which excess serves to cool the gases of combustion to the proper point for feeding the engine, but since the whole amount of the fuel is admitted together with the whole amount of the comburant, the ignition becomes difficult, especially if the gas is to be supplied to the engine at a low temperature, so that the combustion is imperfect, and a part of the comburant remains in the gases discharged from the generator without being consumed, and hence without having increased the energy for power uses to the possible limit. Back-firing of the mixture will also occur in the pipe between the generator and the engine, or in the engine itself.

However, by supplying fuel at successive points on the path of the gases in combustion, it is feasible to burn the whole of the comburant in the interior of the generator and hence to utilize it to the maximum degree of the production of energy, and without danger of the backfiring above mentioned.

The said invention comprises other features by which the energy will be increased, while limiting the temperature of the gas to a degree at which there will be no damage to the engine.

In the diagrammatic drawings which are given by way of example:

Fig. 1 is an axial section of a gas generator according to the invention comprising two combustion chambers and a vaporizing chamber.

Fig. 2 is an axial section of a simplified gas generator comprising two combustion chambers, the last chamber also serving as a vaporizing chamber.

Figs. 3, 4 and 5 are modifications of this simplified construction.

As shown in Fig. 1, the said generator comprises a strong casing 1 which is divided into three chambers 2—3—4 by the partitions 5—6, these being each provided with a central aperture for gas circulation. The comburant is admitted at 7 into the chamber 2, and is subdivided by a distributing device, for instance a perforated concave member 8 situated at the upper part of the said chamber; the comburant is burned for the major part in the interior of the latter in contact with the fuel which is injected by means of a sprayer 9 of suitable construction.

In this apparatus, the combustion chamber 2 is bounded by a thin wall 10 which extends throughout its whole length and terminates in the form of a nozzle 11 disposed in the central aperture of the partition 5. The annular space 12 between the wall 10 and the

casing 1 communicates by the small orifices 13 with the annular channel 14 which is connected with a pipe 15 supplying liquid fuel, and preferably the fuel which is employed in the sprayer 9. The annular channel 14 and the orifices 13 serve to assure the regular distribution of the fuel in the annular space 12.

The fuel which passes through this annular space 12 becomes heated, is partially or wholly vaporized and in some cases it is more or less completely decomposed into gases whose reaction with oxygen is very active (hydrogen, methane and the like). The fuel thus prepared will enter the nozzle 11 through the small orifices 16 formed on its periphery, and thus mingles with the gases discharged from the chamber 2, at a point at which the gas stream has a reduced cross section. Due to these conditions, the gases and vapours will be properly stirred up and mixed, and this assures the combustion of the last parts of the comburant in the supplementary combustion chamber 3. It should be noted that when issuing from the nozzle 11, the gases will have a much larger flow section in the chamber 3, so that their speed will be reduced, with the formation of whirls which further the complete combustion of the comburent.

The chamber 3 is bounded by the thin wall 17, terminated by a nozzle 20 which is situated in the central opening of the partition 6 and which forms around the said chamber an annular space 18, connected through the orifices 22 with the annular channel 21 which is supplied with a cooling liquid by the pipe 23; the space 18 is connected with the nozzle 20 by the small orifices 24. The cooling liquid passing through the space 18 becomes heated and vaporized, (it may also be decomposed) and is injected through the orifices 24 into the stream of gas discharged from the chamber 3; it is thus completely vaporized or decomposed, and is mixed in the chamber 4 with the products of the combustion and lowers their temperature before they are supplied to the engine through the discharge orifice 25.

The narrowing of the chambers 2 and 3 at the bottom affords an advantage, since these parts form an obstacle to the streams of the reacting bodies and these latter are more effectively stirred up.

Although the parts of the wall 10 or 17 converging towards the nozzle 11 or 20 are directly in contact with the flame, they will effectively resist the destructive action of the latter, since they are thin and are well cooled by contact with the liquid and vapours circulating through the annular space 12 or 18.

The cooling liquid is injected into the gases of combustion solely at a point at which the whole of the comburant is already burned, so that there will be no danger of improperly arresting the combustion by this supply of liquid, as may occur in the known generators in which a cooling liquid is supplied to the combustion chamber at a point at which the combustion commences or is still very incomplete, and the fact that water is usually employed as the cooling liquid tends to make this occurrence more frequent.

With my said generator, water may be utilized without any premature stopping of the combustion nor will there be any ignition of the gas in the pipes; however it may be advantageous to substitute for the water a cooling liquid which is itself a combustible, such as petrol, gasoline, alcohol or the like, or a liquid having thermo-dynamic or thermo-chemical properties of such nature that for a given amount of heat used to vaporize it, there will be obtained a weight of the vaporized body which will supply a greater amount of energy than water will produce, when expanding between given pressures, if a turbine is used, or between given volumes, for reciprocating engines. This is the case for example with ethyl alcohol.

To increase the energy supplied, it may be useful to more or less heat the liquid to be vaporized before it is admitted to the generator, so as to decompose it into substances which will afford a better output.

For instance in the case in which the said liquid is ethyl alcohol, the following decomposition may be obtained by the use of a suitable temperature:

$$C_2H_6O = H_2 + CH_4 + CO$$

Although this reaction absorbs heat, it will finally produce a greater number of gaseous molecules at a determined temperature and pressure, which is chiefly favourable for the supply of a reciprocating engine.

It might be supposed that this preliminary preparation of the cooling liquid is of no use, considering that this decomposition takes place when the liquid to be vaporized meets with the hot gases.

This however is not true. The use of catalysts is often indispensable. Even should the heat act alone, the operator is not able, when making injections into the gas, to regulate the temperature supported by the injected liquid, and decompositions of quite another kind which are less favourable to the efficiency may take place.

Fig. 2 shows a simplified construction which differs from Fig. 1 by the elimination of the chamber 3, the wall 17 and the pipe 23. Herein I employ only an additional supply of fuel which is delivered through the orifices 16 into the nozzle 11 and which completes the combustion of the last parts of the comburant in the chamber 4. I thus inject a considerable amount of fuel, so that the gases discharged from the generator will be properly cooled.

This simplified apparatus may prove satisfactory, if its size, shape and supply are properly determined. The ignition in the first chamber 2 will always take place, since the proportion of fuel is not excessive, and the completion of the combustion will be practically assured by the fact that the temperature of the comburant meeting with the fuel and completing the combustion of the fuel and cooling the latter, is sufficiently high.

The amount of comburant which should be burned in each of the combustion chambers to obtain the optimum result will be shown by experiment.

In the present invention, I am thus enabled in all cases to obtain the advantages offered by the complete combustion of the comburant and those resulting from the use of a single liquid, which advantages consist in a great simplifying of the arrangement, so that the apparatus will be lightened, and other advantages are afforded.

In the various constructions herein specified the stirring or mixing of the fuel with the gases issuing from the first combustion chamber results from the disposition of the small orifices 16 around the nozzle 11 and from the subsequent enlarging. I may obviously employ for the same purpose any other suitable means for subdividing and deflecting the streams, and these can be properly deflected by the use of thin walls which are suitably cooled.

As shown in Fig. 3, the wall 10 of the combustion chamber forms a restricted part 26 which separates this chamber from the next; the hollow ring 27 is held in the said restricted part by various tubes 26 for the circulation of the vaporized or decomposed fuel issuing from the annular space 12; this fuel is discharged into the products of combustion leaving the chamber 2, through the small orifices 29—30 in the wall of the ring 27.

The modified apparatus shown in Fig. 4 differs from the preceding from the fact that the ring 27 is replaced by a hollow device 31 of a somewhat conical shape, provided with the small orifices 29—30 for discharging the combustible into the annular stream of gas which flows from the chamber 2 into the following chamber.

Fig. 5 shows another construction in which the wall of the combustion chamber consists of a tube 32 which is wound in a spiral worm with the spiral turns in close contact, the outline of this wall resembling that of the wall 10 (Figs. 1 or 2). The fuel supplied to this worm is vaporized or is decomposed more or less completely and issues through a set of small orifices 34 in the last turns, and is thus discharged into the restricted part of the stream of gas leaving the combustion chamber.

From these examples it will be observed that the forms of construction of the several parts of the generator may vary considerably without any change in the essential features of the invention. It should be further noted that the appended drawings are of a diagrammatic character, and for instance they do not represent the ignition device which forms part of all gas generators of this class and is known per se.

Having thus described my apparatus, what I claim as new therein, and my own invention, is:

1. In a pressure fluid generator adapted to be supplied with a liquid fuel and a gaseous comburant, the combination of a receptacle with resisting wall and divided by means of partitions into three successive compartments, a hollow body with a thin wall in the two first compartments and adapted to provide between itself and the wall of the receptacle an annular space, the said hollow body being provided with an outlet nozzle which opens into the following compartment through the respective partition, and the said nozzle having in its wall orifices for causing the annular space to communicate with the interior of the said nozzle, means for injecting the whole of the comburant and part of the liquid fuel into the hollow body of the first compartment, and means for introducing the rest of the fuel into the annular space around the first hollow body, and for introducing a cooling liquid around the last hollow body, the said liquids being adapted to become heated in the said annular spaces and to cool the said hollow bodies.

2. In a pressure fluid generator adapted to be supplied with a liquid fuel and a gaseous comburant, the combination of a receptacle with a resisting wall and divided by means of partition into two successive compartments, a hollow body with a thin wall in the first compartment and adapted to provide between itself and the wall of the receptacle an annular space, the said hollow body being provided with an outlet nozzle which opens into the second compartment through the respective partition, and the said nozzle having in its wall orifices which cause the annular space to communicate with the interior of the said nozzle, means for injecting the whole of the comburant and part of the fuel into the hollow body of the first compartment and means for introducing the rest of the liquid fuel into the annular space around the said hollow body.

In testimony whereof I have hereunto affix my signature.

RENÉ PERRIN.