COMBUSTION SYSTEM FOR PRODUCING HIGH TEMPERATURE
AND HIGH PRESSURE GAS

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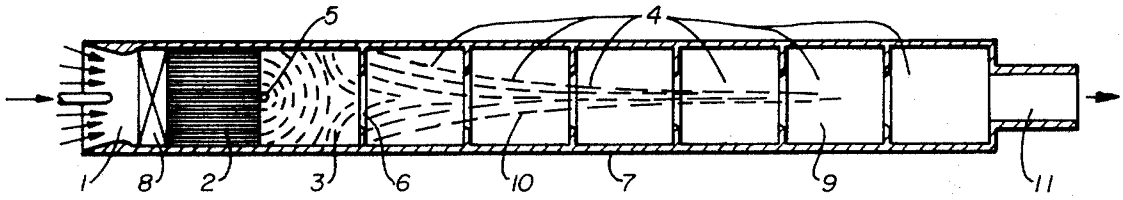

Fig. 1.

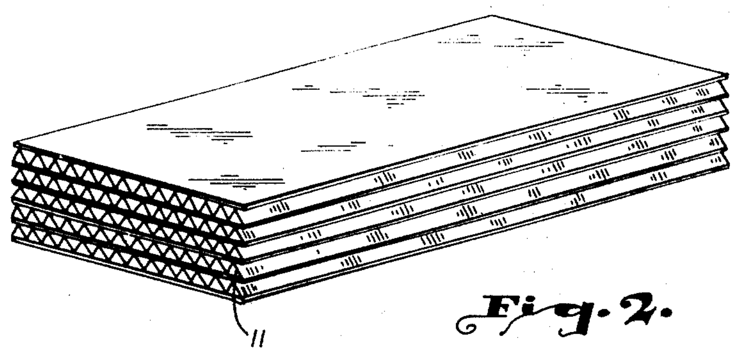

Fig. 2.

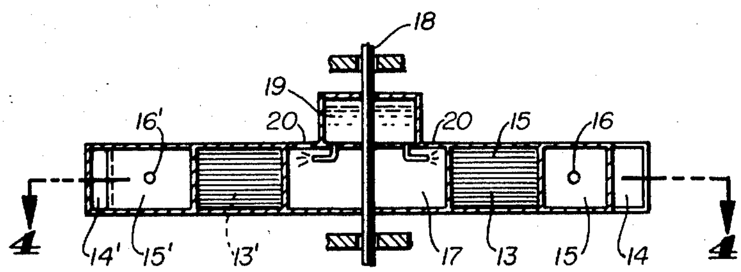

Fig. 3.

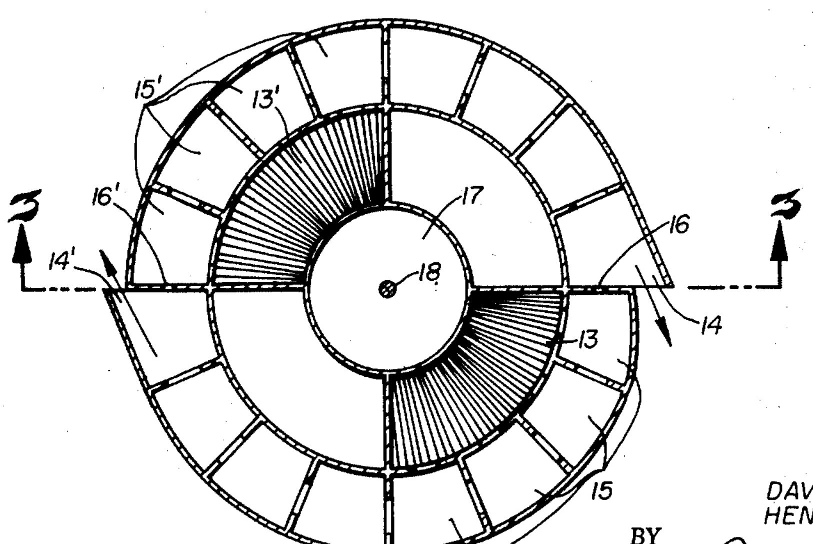

Fig. 4.

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COMBUSTION SYSTEM FOR PRODUCING HIGH TEMPERATURE AND HIGH PRESSURE GAS

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ABSTRACT OF THE DISCLOSURE

A new and novel combustion system which produces high temperature, high speed and high pressure gas by introducing a combustible gaseous mixture into the system through a series of laminated narrow spaces known as interstice into a first segmented cell for ignition, the first segmented cell being complemented with adjacent cells, each of the combustion cells being separated by a wall with an orifice opening centered approximately in each wall section.

This invention relates to a novel means for converting fuel into useful energy. Presently there are many devices available for changing fuel into useful energy—some require heat exchangers and compression chambers to operate; some require moving pistons and valves; while others have approached the subject by low-pressure burning. However, the inventive concept present in our invention is different than the following patents which are hereby made of record.

The patent to Klein, No. 3,175,357, issued Mar. 30, 1965, discloses a method and apparatus for producing compressed operating gas, but the principle of combustion oscillation detonation which Klein discloses and the apparatus for carrying out the principle of combustion differ from the principle and apparatus which we shall disclose. The Klein patent shows structure which differs from the inventive concept which we shall disclose, consequently the resultant detonation which takes place in the air chambers is not of the same nature as produced by the apparatus which will be disclosed. The detonations in the Klein disclosure are independently produced, being produced by an oscillating regenerative gas generator with the aid of reflecting walls. The apparatus which we shall disclose produces detonations not independently produced and are produced by many simultaneous internal explosions.

FIG. 1 illustrates a cross-sectional side view of the combustion system.

FIG. 2 illustrates an isometrical view of an interstice.

FIG. 3 illustrates a cross-sectional side view through line 4—4 of the combustion system in a circular pattern.

FIG. 4 illustrates a cross-sectional top view through line 3—3 of the combustion system in a circular pattern.

The patent to Bertin et al., No. 2,825,203, issued June 24, 1952, discloses an aerodynamic valve in combination with a resonant firing combustion chamber containing a fuel injector and a spark plug for ignition. The purpose of the aerodynamic valve is to prevent the combustible gas from flowing backward from the combustion chamber to the compressor. This apparatus will not produce the principle of combustion which we shall disclose since the apparatus is structurally different and can not produce the pattern of simultaneous detonation disclosed by our invention. The patent to Goddard, No. 2,551,112, issued May 1, 1951, shows a premixing chamber with a screen for the passage of vaporous materials into a chamber to produce turbulence and eddies in the gas stream passing between the two chambers having a pressure differential. The Goddard patent does not disclose a combustion chamber as we shall disclose, but a screen structure not the series of narrow spaces referred to in this application as an interstice. The screen and partition structure disclosed in Goddard with the balance of the apparatus shown does not perform in a manner similar to an interstice in combination with the apparatus disclosed herein. Again, this patent does not reveal our concept. The patent to Wislicenus, No. 2,618,925, issued Nov. 25, 1952, discloses a flow control for a pulse-jet combustion unit with gas movement through a vane structure to eliminate a flap valve. All of the above-described patents deal with single cell combustion chambers, except the patent to Klein which shows a single, not a simultaneous, detonation of gas in each chamber.

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The object of this invention is to produce useful energy by employing fuel in various forms in the apparatus disclosed.

Another object of this invention is to pass a fuel mixture through narrow laminated paths into a series of cells making up a combustion chamber to produce simultaneous explosions in the cells.

Still another object of this invention is to provide apparatus for re-burning of a portion of the products of combustion.

The present invention combines two theories: (1) the introduction of a fuel mixture into a combustion chamber through a novel device which shall be referred to as an interstice; and (2) a combustion chamber of novel design.

FIG. 1 discloses a schematic drawing showing a mixing chamber **1** in which fuel and air are mixed. Fan means **8** between the mixing chamber and interstice **2** for initial movement of the mixture; an interstice **2** for feeding the fuel mixture into the combustion chamber **7** which is made up of a multiplicity of combustion cells, and an initial combustion cell **3** equipped with means **5** to ignite the fuel mixtures, a series of adjacent cells **4** with orifice means **6** between the cells and an exhaust means **11.** In operation, the fuel mixture is fed through the interstice into the combustion chamber **7.** Upon the admission of the fuel mixture at this point, it is ignited by a spark means **5** forming a flame front which immediately passes through a series of orifice openings **6** located between the adjacent cells. This flames front provides a tongue of flame that accelerates at a rapid rate as it passes through the orifices **6** from cell to cell, reaching an extremely high speed and high pressure. The high pressure developed by the gaseous exploding mixture in the tongue of flame, compresses the exploding fuel mixture into the exhaust end. The speed of the tongue of flame which is created by the exploding fuel mixture is far greater than a normal flame front commonly found in other devices and ignites any residue fuel mixture which is present in each cell as it travels. Accordingly, the tongue of flame passes through all the cells before the fuel in most of the cells has completely burned, thus all of the fuel mixture in the cells is burning at the same time. Because of the simultaneous burning of the fuel in the cells, the extremely high exhaust speeds temperatures and pressures which are produced are not realized by conventional flame fronts or turbulent combustion produced by other devices.

Further, to clarify this phenomena, immediately after the combustion is complete in the cells, a sharp pressure drop occurs resulting in an implosion. This implosion coupled with the rush of exhaust gas from the exhaust port **11** will induce a new charge of fuel mixture to enter into the combustion cell **7** from the interstice **2.** During the recharging cycle, the products of combustion near the inlet, which burn in a lower pressure environment, do not burn to complete combustion; therefore, they are not completely consumed but mix with the new charge of fuel as it passes through the series of combustion cells toward the exhaust. At the beginning of a cycle, the fuel mixture near the ignition device is rich and undiluted and burns with ease, while the fuel mixture in the later cells toward the exhaust port contain products of combustion and some unburned fuel. During ignition the burning starts in the cell near the fresh fuel mixture inlet end under a fairly low pressure. As the ignited gaseous mixture passes rapidly from cell to cell through the orifice opening, the accompanying flame front which increases in speed provides increasingly higher pressures. As a result, the burning in the cells toward the exhaust takes place under high pressures and temperatures. This results in the conversion of the new fuel and the unburned fuel from the exhaust gas of the previous burning to be consumed to a high degree. It is this re-burning effect that results in the high efficiency of fuel conversion and minimizes polutants of exhaust. In addition, direct injection of fuel, water, oxidizing agents or catalysts may be made into any of the cells, depending on the particular desired application.

The combustion system is not confined to only one combustion chamber made up of a series of cells, but can be resolved into many combustion chambers. After initial ignition in a multi-unit system of chambers, the ignition means for starting the flame front in any of the other adjoining chambers can be located in the last cell of the initiating combustion chamber and/or the last cell of the adjoining chamber in the shape of one or more small holes. By including one or more small holes from one combustion chamber to another, the pressure and heat from the ignited fuel in one combustion chamber will ignite the fuel which has entered through the interstice in a second combustion chamber equipped with a separate interstice and likewise in an adjoining series of chambers. This operation can be repeated in as many combustion chambers as the desired results require.

FIG. 2 is a drawing showing the interstice. The interstice can be fabricated from any suitable material, depending on the physical properties required. Alloys of steel, aluminum, copper, magnesium and other material are preferred because of their heat conductance and for economic reasons. The interstice can be formed in a composite so as to create triangular spacings **11** as illustrated or in any other suitable pattern of spacing. However, the pattern must always be such as to form an easy path for the low pressure inflow of the fuel into the combustion chamber. It must also be designed to restrict the high pressure short duration explosion within the area occupied by the flame front, and prevent the passage of the flame front from returning through the interstice into the premixing chamber.

The design of the interstice is determined by the consideration of many factors. It must be so designed that the cooling effect of the spaces is such that it will cool the flame front to extinguish it if it retracts partially into the lateral spaces of the interstice. The cross-sectional size and shape of the path as well as the length of the path which are considered within the skill of the art are important considerations. As an example, if the spacing in the cross-sectional area is equal to approximately 0.70 square inch, the length of the laminated triangular lateral spaces should not be less than 4 inches. Ideally, a length of from four to seven inches will suffice if the mixture of fuel is a combustible gas such as 10% methane in air at atmospheric pressure. Changing the type of fuel may necessitate any adjustment in the cross-sectional areas or length of the laminated triangular lateral spaces. To obtain the maximum flame throughout the combustion system, experimentation has proven that a 0.70 square inch cross-sectional area and a four inch longitudinal measurement will give ideal combustion for a mixture of methane in air. Other factors to consider in the design of the interstice would be the operating pressures and the type of fuel mixture feeding into the system, their flow characteristics and the materials of construction.

FIG. 3 is a drawing showing a side sectional view of two combustion chambers in a circular pattern, rotating on a shaft **18** about a center line. This drawing is a means of illustration only and does not intend to limit the operation to only two combustion chambers.

FIG. 4 is the top sectional view. In this application, the premix chamber **17** is supplied by fuel **19** and air through ports **20** as shown in FIG. 3, and is shown feeding the fuel mixture into interstices **13** and **13'** FIG. 4. The fuel mixture passes through both of the interstices into the combustion cells **15** and **15'**. Although any of the combustion cells can be affixed with an ignition device, it is preferably located in a combustion cell adjacent to the interstice. For continuous ignition, a small opening **16** and **16'** may be located in either or both of the end cells of each chamber, and after initial ignition with a glow wire or a spark plug, the first chamber will continue to ignite the next chamber through these small openings connecting the chambers. The second chamber likewise will ignite the first chamber, thus obtaining continuous operation without the repeated use of the glow wire after the initial lighting. In this particular disclosure, the combustion products exhaust from each series of cells at **14** and **14'** to give a pulse-jet effect to the circular combustion chambers. It should be noted that in this particular application, the fuel mixture is being supplied to each of the four cells **15** and **15'** in each of the combustion chambers.

Suggested means for supplying the fuel to the premixing chamber **17'** are a carburetor, a natural gas mixer, a fuel injector or any other type of a device which is suitable for placing the fuel into the premix chamber **17**. As was previously stated, the fuel mixture passes from the premixing chamber through an interstice into the combustion cells. The ignition and detonation of the fuel proceeds in the same manner as described above in the paragraph under FIG. 1. The high energy gas from the flame front exhausting outwardly with a jet effect creates the movement of the circular combustion chambers attached to a center shaft in a circular direction.

In another application, the combustion chambers either singularly or in a series may remain stationary with the exhaust reacting on a movable member such as a turbine wheel or both the turbine wheel and the combustion chamber, in another application, may be allowed to rotate simultaneously. The exhaust gas may also be used to drive other devices such as pistons.

Useful applications of this invention are manyfold and include heating by the exhaust gas or by conduction through the walls of the combustion chamber and exhaust port; propelling an airplane using the jet principle or providing rotational motion to drive such devices as a car or generator.

We claim:

1. A combustion system for creating high temperature, high pressure gas comprising at least two combustion chambers, and a common premixing chamber for a combustible gas mixture, the said combustion chambers being interconnected and arranged in a closed curve, each of the said combustion chambers having at least a first and second combustion cell in flow series, the said first combustion cell having means to ignite the said combustible mixture entering therein, the said first and the said second cell being arranged in a juxtaposition one to the other, at least one wall partition containing orifice means, the said wall partition being positioned between the said first and the said second cells, the said orifice means being centered approximatly in the center of the said wall partition, each of the said combustion chambers having an independent interstice, the said interstices being positioned between the said premixing chamber and the said combustion cells, each of the said interstices feeding the combustible gas mixture into at least one of the said combustion cells in each of the said combustion chambers.

2. The combustion system as claimed in claim **1** where the last combustion cell in each of the said combustion chambers has a small opening so as to provide continuous ignition of the combustible gas mixture in each of the said adjoining combustion chambers.

References Cited

UNITED STATES PATENTS

2,212,186	8/1940	Ricardo	138—40
2,480,540	8/1949	Bodine	60—247
2,551,112	5/1951	Goddard.	
2,612,749	10/1952	Tenney	60—249
2,657,708	11/1953	Kamm	60—247
2,670,597	3/1954	Villemejane	60—39.52
2,722,180	11/1955	McIlvaine	60—39.77
2,805,545	9/1957	Wilman	60—39.52
2,825,203	3/1958	Bertin.	
3,175,357	3/1965	Klein.	
3,362,166	1/1968	Sippel	60—39.72
2,632,294	3/1953	Wall	60—39.77

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