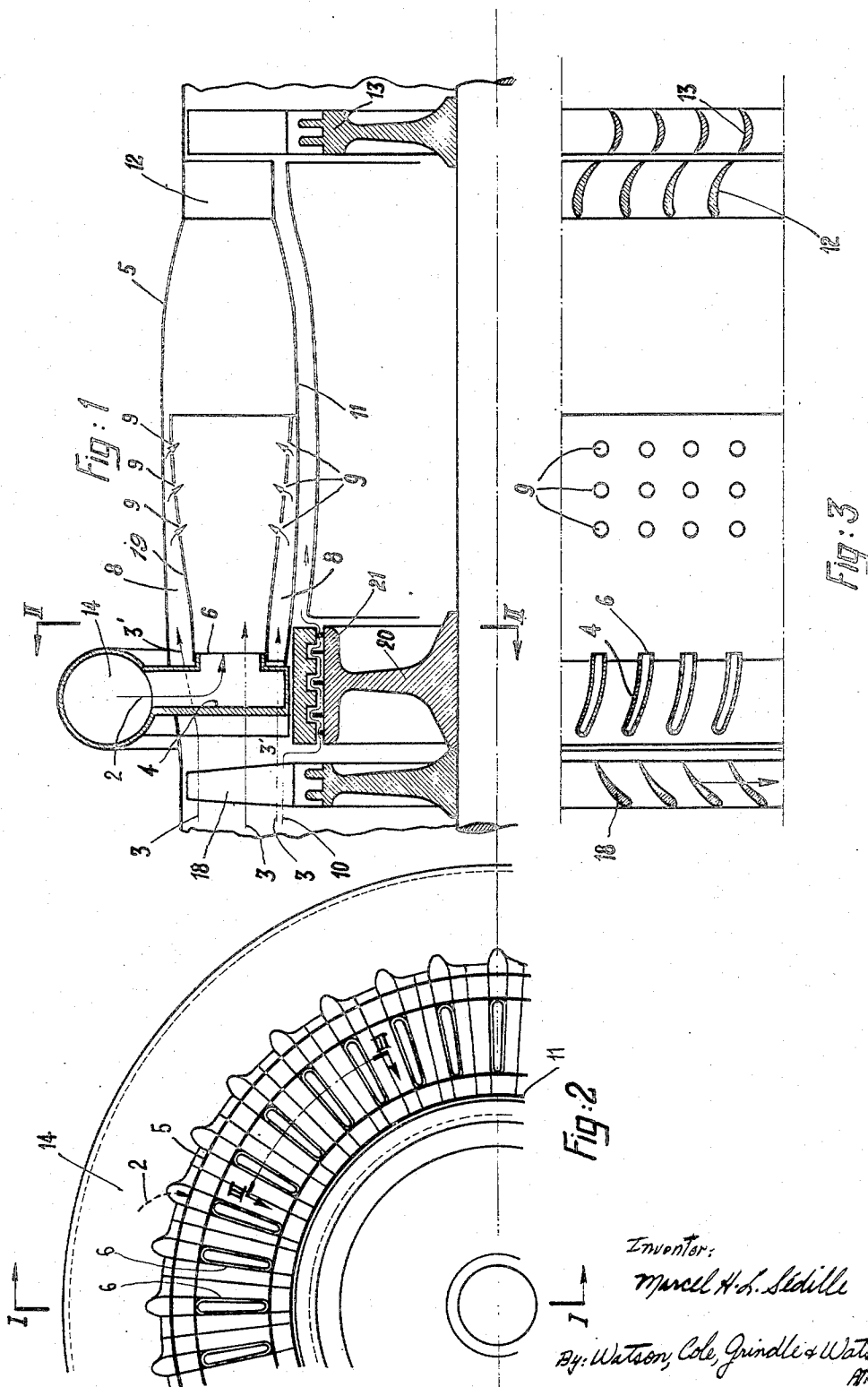


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ANNULAR COMBUSTION CHAMBER WITH HOLLOW AIR GUIDE VANES
WITH RADIAL GASIFORM FUEL SLOTS FOR GAS TURBINES
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ANNULAR COMBUSTION CHAMBER WITH
HOLLOW AIR GUIDE VANES WITH RADIAL
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BINES

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In gas turbine plants, it is desirable that the combustion of fuel be complete and effected inside a chamber of smallest possible size.

This latter condition is compulsory for certain applications such as marine propulsion, traction and aviation. In the case of gaseous or gasified fuels, practice shows that the performance of complete combustion over a minimum path depends on the multiplicity of the contact surfaces between the air and the fuel. A great number of ordinary gas burners satisfying these conditions are known but they show however excessive losses of head either for the combustive air or for the gasiform fuel.

In these known arrangements, in order to achieve a rapid and complete combustion, the diffusion of the gasiform fuel inside the combustive air is furthered either through the different speeds given to the air and to the gas at the outlet of the burner or through obstacles giving rise to a considerable turbulence of the gaseous mixture thus promoting the desired diffusion. These methods lead however to important losses of head for one of the two flows considered. Now it is known that these losses of head are particularly detrimental in the case of gas turbine plants and that they reduce by a considerable amount the efficiency of such plants.

The present invention has for its object an arrangement of a combustion chamber and burners adapted in particular for use with gas turbines whereby the losses in head of the gaseous current are reduced to a minimum and yet an intimate contact is ensured between the gasiform fuel and the combustive air.

To this end the flow of gaseous fuel and the flow of combustive air are divided into thin gaseous alternate sheets, each gaseous fuel sheet lying between two sheets of combustive air and vice-versa, so as to provide a contact surface as large as possible between said two fluids. In accordance with the invention, the burners, i. e. the nozzles feeding gaseous fuel sheets have preferably the shape of a narrow slot located at the end of a flat pipe the outer surface of which forms a partition dividing the air stream. Thus an air sheet is produced between every two consecutive such pipes, said air sheet being in contact throughout both its surfaces with two fuel sheets each of which is itself in contact with two air sheets. A radial arrangement of the burners thus gives rise to radial gas sheets alternately composed of fuel and of air.

According to an embodiment of the invention, the flattened gas feeding pipes are arranged in

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radial formation. The burners are connected to an annular inlet manifold located outside the combustion chamber and they are also radially arranged and directed parallel to the axis of the chamber. In this embodiment also, the slots of the burners conveniently narrow down towards the centre.

The burners may be connected through relatively long pipes having conveniently a flat shape to a manifold located at an appropriate distance from the combustion chambers. Thus means for adjusting the passage cross-section of the ducts can be fitted up on the portions of said pipes lying outside the combustion chambers.

The flattened pipes arranged radially play the part of stationary guiding fins for air discharged by the compressor and direct this air parallel to the outlet direction of the gaseous fuel issuing from the burner. Part of the air thus directed is not used immediately for the combustion but for the cooling of the walls of the combustion chamber. It is only then mixed with the combustion products. The combustion chamber itself may have a cross section which increases along the flowing direction of the gases, so as to avoid the gradual acceleration of the gaseous flow. Let S_0 be the cross-section of the chamber in front of the nozzles of the burners and T_0 the absolute temperature both of the gaseous fuel and of the air at the inlet into said chamber, the cross-section S_1 at the outlet of said chamber is preferably such that if T_1 is the absolute temperature of the gaseous products of the combustion at the outlet, the following equation is satisfied:

$$\frac{S_0}{S_1} = \frac{T_0}{T_1}$$

Other objects and advantages of the invention will be apparent during the course of the following description.

In the accompanying drawing forming a part of this application and in which like numerals are employed to designate like parts throughout the same:

Fig. 1 is a fragmentary axial section of the gas-turbine plant taken along line I—I of Fig. 2;

Figure 2 is a cross-section taken along line II—II of Fig. 1; and

Fig. 3 is a developed section taken along line III—III of Fig. 2.

In the drawing, 13 designates the last movable blading of the axial compressor; the latter discharges between the fins 4, air which divides into primary air (arrows 3) which directly takes part

in combustion and secondary air (arrows 3') which flows between the fins in the portions thereof which do not lie opposite a fuel gas outlet into the chamber, whereby secondary air is not directly used for combustion. The stationary distributing fins 4 give the air issuing from the blading 18 of the compressor an axial direction; these fins are hollow and connected to the gaseous fuel inlet manifold 14. Each fin 4 thus constitutes an elementary burner and the gaseous fuel issues therefrom as a thin sheet through an aperture provided in a fraction of the trailing edge 6. The combustion takes place inside a diverging annular duct 19. The fraction of air delivered by the compressor and forming the secondary air stream does not enter directly the combustion chamber but flows around it along annular space 8 in the direction of the arrows 3', thus cooling the walls of the chamber; it is finally admixed with the combustion products by passing through the ports 9 in said chamber walls. Lastly the axial compressor is generally provided with an equilibrating piston 20 adapted to compensate the axial thrust and comprising at its periphery a quincunx fluid-tight packing 21. The air which leaks through this packing is used to advantage for forming a circulation of cool air around the combustion chamber; thus a portion of the outer wall 11 is cooled and preserved from the high temperatures prevailing inside the combustion chamber and may bear without any difficulty the overpressure of the driving gases. Lastly in Figs. 1 and 3, 12 corresponds to the distributor of the gas turbine and 13 designates one of the movable wheels thereof.

In the above forms of the invention, large contact areas between the two flows of gaseous fuel and combustive air are obtained owing to the thin outlets. Moreover the burners only offer a minimum resistance to the principal flow of combustive air.

In the combustion chamber itself, the amount of heat evolved by the combustion causes an increase in the volume of the fluids circulating therein; if the combustion chamber had a constant passage cross-section, this would result in an increase in speed of the combustion products leading to a reduction in the pressure of the driving gases and consequently to a loss of head. To avoid this drawback, the combustion chamber is given, as shown in Fig. 1, an increasing cross-section from the inlet towards the outlet.

Let S_0 and T_0 be respectively the cross-section of the combustion chamber in the vicinity of the inlet, and the absolute temperature of the gases therein, and S_1 and T_1 be the corresponding values at the outlet of the combustion chamber. According to the invention, the ratio $S_0:S_1$ between the cross-sections is given a value as nearly equal as possible to the ratio $T_0:T_1$ of the absolute temperatures, whereby a substantially constant flowing velocity of the combustion products is

ensured up to the outlet of the combustion chamber connected to the distributor of the gas turbine.

What I claim is:

1. A gas-turbine power plant comprising an annular combustion chamber, an axial-flow compressor for supplying air to said chamber, circularly distributed, stationary, hollow vanes at the discharge end of said compressor, adapted to divide the flow of air issuing therefrom into a plurality of generally radial, spaced layers of air, each of said vanes having a generally radial, slot-like passage opening on to said combustion chamber, and a feed manifold connected to said hollow vanes and adapted to supply therethrough gaseous fuel to said chamber, whereby a plurality of generally radial, spaced layers of gaseous fuel are formed between successive layers of air.

2. A gas-turbine power plant as claimed in claim 1 wherein the combustion chamber is disposed inside an annular casing the walls of which are spaced from the walls of the combustion chamber, thus providing for annular passages between the walls of the combustion chamber and the walls of the casing, these passages being in communication on the one hand with the discharge end of the compressor and on the other hand with the combustion chamber.

3. A gas-turbine power plant as claimed in claim 1 in which the combustion chamber has a gradually increasing cross-section along the downstream direction, the ratio between the least and largest cross-sections being substantially equal to the ratio between the absolute temperatures of the gases before and after combustion.

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