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R. LEDUC

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CONTINUOUS FLOW GAS TURBINE

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Fig-1

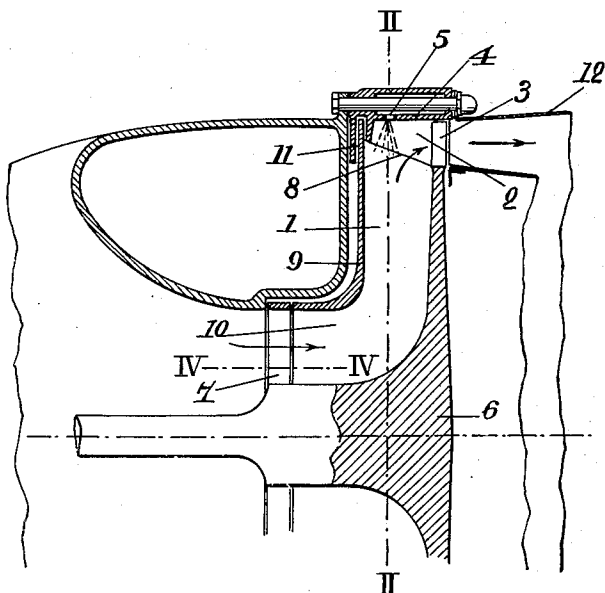


Fig-2

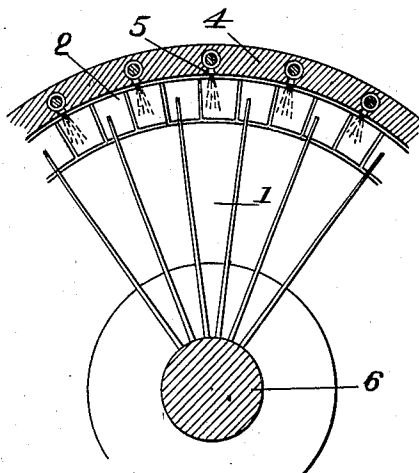


Fig-3

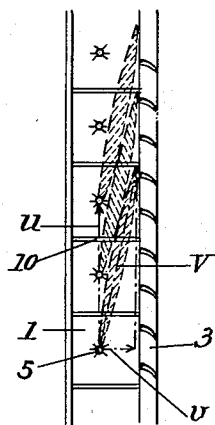
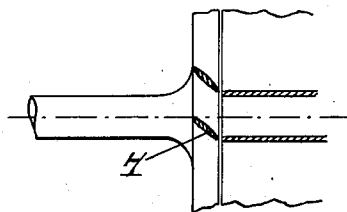


Fig-4



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CONTINUOUS FLOW GAS TURBINE

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1 Claim. (Cl. 60—41)

The object of my invention is to provide certain improvements in continuous flow gas turbines wherein the compression, the combustion and the expansion take place in one and the same rotor.

I have found that the supply of heat to nozzles which are arranged side by side on the periphery of a wheel is effected under poor conditions of efficiency if special arrangements are not used. On the other hand, I have also found that detonations occur at high speeds and that it is impossible to obtain a flame which is sufficiently short to be contained entirely inside the rotor.

According to my invention, I form the turbine by combining a series of compression nozzles radially arranged on a rotor, and a series of expansion nozzles formed by radial blades arranged at the periphery of the same rotor, with an annular combustion chamber which is interposed between these two series of blades and in which the juxtaposed flames of the burners form a substantially continuous ignition ring. The shapes and dimensions of the compression nozzles and of the combustion chamber and the speeds of the gaseous fluids are as far as possible chosen in such a manner that the flames are directed very obliquely and do not extend outside the rotor.

The combustion chamber is formed by a space which is limited on the one hand by the outlet of the compression nozzles and the inlet of the expansion nozzles, which form parts of the rotor, and on the other hand by at least one fixed wall which is secured for example to the outer case. Under these conditions, the gaseous current is involved in considerable turbulence in the combustion chamber, although the gaseous fluid participates in the circular movement of the rotor.

The turbulence is further increased by the fact that said turbine rotates at extremely high speeds, preferably exceeding 10,000 R. P. M., and that the friction of the air at high speed against the above mentioned fixed wall causes a considerable increase of the temperature of the boundary layer, thereby considerably increasing the speed of propagation of the flame.

Furthermore and in order to still further increase the turbulence, I distribute the burners at the periphery of the turbine, at a short distance from each other, so that their flames are substantially in contact with each other and the fuel burns in a kind of ring of fire.

By way of example and in order to facilitate the comprehension of the ensuing description, an

embodiment of the invention has been shown in the accompanying drawing in which:

Figure 1 shows a longitudinal section of a turbine according to the invention.

Figure 2 shows a section along the line II—II of Figure 1.

Figure 3 shows the development of the periphery of the rotor.

Figure 4 shows a partial diagrammatical view in section along the line IV—IV of Figure 1.

In the example shown in Figures 1, 2 and 3, the turbine comprises a rotor provided with radially juxtaposed nozzles forming an arrangement which is divided into a compression zone 1, a combustion chamber 2 and an expansion zone 3.

The compression zone 1 is formed by the two discs 6 and 9 between which are arranged blades 10 (Figure 3) which form radial partitions which limit divergent radial nozzles.

This arrangement provides, inter alia, the advantage of balancing the thrusts so that the resultants of same on the main shaft is substantially nil. The inlet to the compression zone is preferably formed by means of an inlet helix 7 which is intended to eliminate sudden changes of direction in this part of the apparatus.

The second disc 6 of the rotor carries at its periphery expansion blades 3 which are free at their outer ends since at the extremely high speed in question outer bracing members would not withstand the stresses developed and because it is not necessary to obtain a perfect fluid-tightness at this point.

The combustion chamber 2 is formed by the space which is limited on the one hand by the fixed wall 4, and on the other hand by the outlet 8 of the compression nozzles and the inlet of the expansion nozzles 3. Said combustion chamber is therefore of annular shape.

All the way around, and preferably in the fixed wall 4, are arranged burners 5 which inject the liquid fuel into the combustion chamber. Said burners, in the example shown in the drawing, open into the front part of said chamber, so that the flame has sufficient space to extend without exceeding the limits of the rotor.

Owing to the speed of rotation and the effect of the fixed wall, the flame of the burners takes up an oblique position with respect to the axis.

In Figure 3, it will be seen that combustion should take place over a length V if the gases were not in contact with the fixed wall 4. As they are in contact with the wall 4, the general flow takes place along the resultant of the speed in-

side the nozzles *v* and of the peripheral speed *u* and the flame can therefore be of the length *V* while remaining inside the rotor.

It will also be seen in Figure 3 that the various flames touch each other, owing to the empty space outside the terminal edge 8 of the blades of the rotor; a considerable continuity of combustion is thus obtained, so that there is no detonation and consequently the efficiency is increased.

A fluid-tight device is provided at the front part of the combustion chamber, between the fixed wall and the adjacent movable part. In the example shown in the drawing, the outer part of the front disc 9, which extends slightly beyond the edges 8 of the compression blades, penetrates into an annular groove or channel 11 provided in the front part of the fixed wall.

On the other hand, it is not necessary to provide a fluid-tight device between the expansion blades 3 and the fixed part and said blades open freely at their periphery.

When the fluid leaves the expansion blades it still has quite a high speed. This fluid passes into the annular pipe 12 which is coaxial with the shaft of the turbine and slightly divergent.

Under these conditions the speed upon leaving the pipe 12 is less than at the entrance and consequently the energy recovered is added to the

power obtained by the expansion blades 3. The efficiency of the assembly is thereby increased.

I claim:

5 A gas turbine comprising a shaft, a pair of spaced elements mounted upon said shaft, walls extending between said elements located in planes extending through the longitudinal axis of said shaft to form divergent movable compression nozzles, one of said elements having an
10 opening therein located adjacent said shaft to form with said walls entrance orifices for said compression nozzles located nearer said shaft than the exit orifices of said compression nozzles, a single stage of expansion blades mounted upon
15 the peripheral portion of the other of said elements, a fixed wall concentric with said shaft cooperating with said blades to form expansion nozzles, said fixed wall extending over the exit orifices of said compression nozzles to form a
20 combustion chamber located between said exit orifices of said compression nozzles and the entrance orifices of said expansion nozzles, burners located in said combustion chamber and means for leading fuel to said burners, said fixed wall
25 being provided with an annular groove and said element which has an opening therein having its peripheral portion extending into said groove.

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