Defining the maximum performance of the gas turbine

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***Abstract* – Geothermal water having low temperatures are known to have many opprotunities of usage. Out of these geothermnal sources with temperatures higher than 300 ºC, one of the most important usage is that of producing electric power.**

On the University of Oradea, there is a tradition of producing electric power out of low temperature geothermal energy. We would like to mention, that until now we have used more appliances like this, having a power of 100 kW and 1 MW. These technical solutions were patented. In Switzerland, Genoa we have received a golden medal. [1].

I. INTRODUCTION

In this article we would like to present a new solution, where the engine of the generator, which until now was a 12 cylindrical boxer engine was replaced by a turbine. And if we make changes, than we would add that we would like to use the turboexpander (see figure 1) which is made up of a gasturbine, a generator and an inverter, which works together with the network. The model proposed by us is totally automated, it is perfect for small, isolated users, but the electricity produced can be led into the national network as well.

Using this turboexpander we have come to a convertor, which transforms geothermal energy into alternative energy. This system satisfies the needs of isolated industrial consumers and those of use energy from the national network.

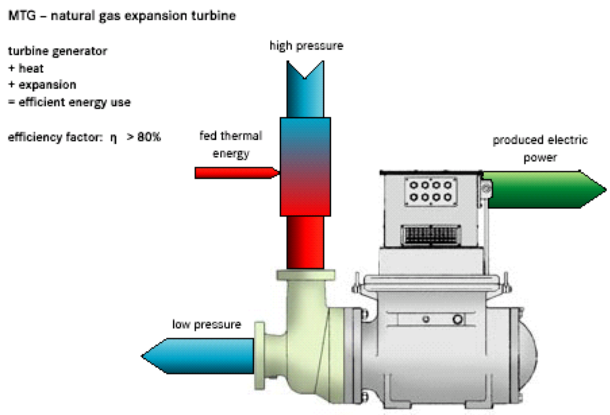

Figure 1

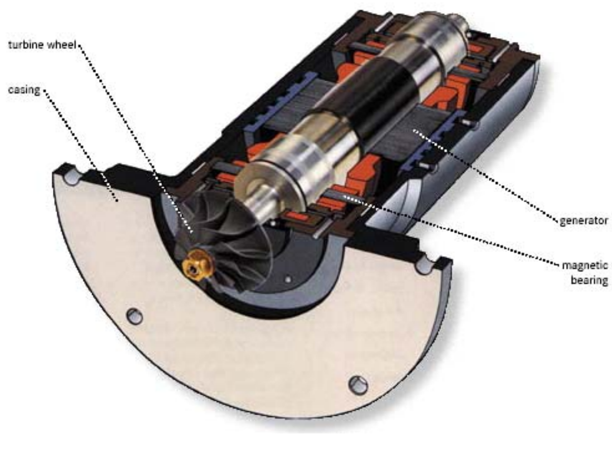

Figure 2

As figure 2 . presents the realation between the turbine and the generator is through magnetic ways. Taking into consideration the parametres of the system, we would like to establish the maximum theoretical value of mechanic performance.

II. DEFINING THE MAXIMUM PERFORMANCE

We should define the performance of the turbine. For this let’s consider the process inside the turbine. The energy change (ΔE of the material (Δm) is made on behalf of the speed change. (Δv)

$$\Delta E = \frac{1}{2}\Delta m\left(v_i^2 - v_f^2\right) \quad (1)$$

where: v_f – speed of outlet gas from turbine;
v_i – speed of the inlet gas in the turbine.

The quantity of the material depends on (Δm) the density of the gas material and of its speed. (ρ),.

$$\Delta m = \rho S v_i \Delta t \quad (2)$$

The output in this case can be calculated

$$P = \frac{\Delta E}{\Delta t} = S v_i \frac{1}{2}\rho\left(v_i^2 - v_f^2\right) \quad (3)$$

From Bernoulli,s law we can infer, that the change of the speed is a consequence of the pressure change. (Δp)

$$\Delta p = \frac{1}{2}\rho\left(v_f^2 - v_i^2\right) \quad (4)$$

Taking into consideration this relation, the value of the output

$$P = S v_i \Delta p \quad (5)$$

Taking into consideration this (Q_m),

$$Q_m = \frac{\Delta m}{\Delta t} = \rho S v_i \quad (6)$$

The maximum mechanic output (5) will have the following form

$$P = \frac{Q_m}{\rho}\Delta p \quad (7)$$

We can notice that the value depends on the value of volume and pressure change.

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