

## CONVERTING INTO ELECTRO-MECHANIC ENERGY THE THERMIC ENERGY FROM THE THERMAL WATER AND SOLAR ENERGY

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**Abstract:** The paper presents a new way of converting into electro-mechanic energy the thermic energy from the thermal water and solar energy. The main element of the conversion system is a new type of thermic motor which works one raised only, having a Stirling type thermo cycle.

**Keywords:** energy conversion, thermal water, solar energy

### 1. INTRODUCTION

Thermal energy is most easily defined in the context of an ideal gas. In a monatomic ideal gas, the thermal energy is exactly given by the kinetic energy of the constituent particles

There are several ways of transforming primary energy into electricity by thermal power processes. This is the process of direct conversion of chemical energy of fuel or the high temperature heat into electricity, avoiding the use of thermal cycles and mechanical work as interim step in the chain of transformations

The use of recyclable resources or new sources of energy to produce mechanical energy (and subsequently power through conversion) thermodynamic cycle, cycle parameters require optimization criterion based on maximum output of mechanical energy in terms of data sources, the hot source open circuit

Geothermal power (from the Greek roots *geo*, meaning earth, and *thermos*, meaning heat) is power extracted from heat stored in the earth. This geothermal energy originates from the original formation of the planet, from radioactive decay of minerals, and from solar energy absorbed at the surface.

### 2. OPERATION PRINCIPLE

The new system of electro-mechanic conversion is made of: *thermic motor, electric current generator, hot water mass and cold water source*. The thermo motor transforms the thermo energy from the thermal water or solar energy, in mechanic energy under the form of rotation movement. The rotation

movement made by the motor is transmitted to the electric current generator, which transforms the mechanic energy into electric energy. In order to complete the thermo cycle it is necessary to have a hot source and a cold source, carried out by a source of hot water and one of cold water.

Any time a motor turns faster than the controlling drive is commanding it to turn, it's no longer a motor but a generator. Instead of *taking* electrical energy from the drive and converting it to mechanic energy, the motor is converting the load's mechanic energy back to electrical energy and *returning* that energy to the drive. This process is called regeneration, and it typically occurs when: Gravity contributes to downhill movement. Anytime a conveyor is going downhill and gravity moves the load faster than commanded motor speed, the motor will regenerate energy. This frequently occurs when a conveyor changes altitude, either from one floor to another, or from the top of a coal mine to the bottom. Load inertia overpowers the motor. For example, a punch press has a spinning flywheel driving a crank that raises and lowers a die; during half of the cycle (raising the die) the load is motoring and during the other half of each cycle (lowering the die), the motor is regenerating. Load speeds are stopped or changed quickly. When users command a decrease in speed, but the load is unable to slow down immediately because of high inertia, the load overhauls the motor and the motor becomes a generator. Using the same punch press example, if an operator needed to stop the press for a new setup, allowing the press to *coast* to a stop would lower productivity.

Instead, the press must be stopped quickly, causing considerable regeneration

### 3. THE THERMIC MOTOR

The thermo motor is made by an energy generator (**GE**), energy accumulator (**AE**), and the engine machine (**MM**) which makes *two energy transformations*, the primary one and the secondary one (*fig. 1*).



**Figure 1: Working scheme of the one-raided engine**

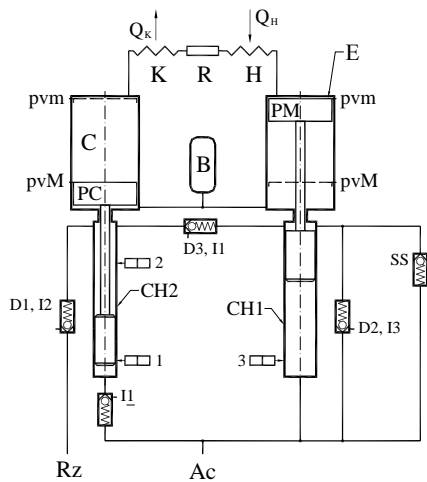
The *primary transformation* is realized by the energy generator, which transforms the thermo energy from the hot water source into hydrostatic energy. The hydrostatic energy is stored in the hydraulic accumulator (**AE**). The *secondary transformation* is made by the engine machine which takes over the hydraulic energy stored in the accumulator and transforms it into mechanic energy, under the form of rotation movement. The way the motor works is the following: the thermo energy generator (**GE**) transforms the thermo energy from the hot water in hydrostatic energy, which is transmitted to the hydraulic accumulator (**AE**) until the oil pressure reaches the maximum admitted limit. In this moment the generator automatically stops working until the pressure in the accumulator drops to the minimum admitted limit. In order to shift the pistons during the resistant courses of the thermic cycle the hydraulic energy from the accumulator is used. The hydraulic oil flow is both way, generator-accumulator and accumulator-generator. The engine machine is a *rotative hydraulic motor* with adjustable flow. The revolution of the hydraulic motor is constant, unaffected by the charge emitted by the electric current generator, through an automatic device of flow adjustment.

The **energy generator (GE)** works automatically, one-raided only. In the generator takes place a *Stirling* type thermo cycle, the motor agent may be nitrogen or helium. It is analyzed the *alpha* ( $\alpha$ ) configuration and the *beta* ( $\beta$ ) configuration. The *gamma* ( $\gamma$ ) configuration doesn't present any kind of interest, because of the imperfect way of the thermo cycle (the compression

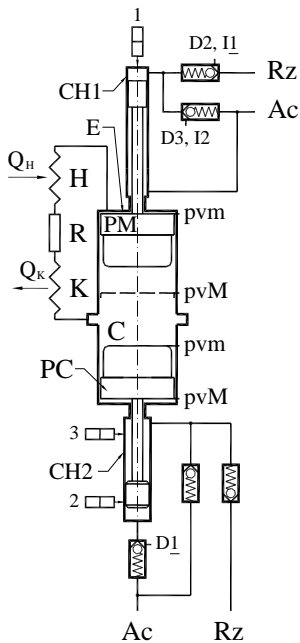
and the expanding take place in the compressor cylinder, at the end of which the cooler is set up).

The *alpha generator* is made up by two cylinders, in which the motor piston (**PM**) and the compressor piston (**PC**) have an alternative-linear movement (*fig. 2 a*). Between the piston (**PM**) and the walls of the cylinder, is the expanding chamber **E**, and the piston (**PC**) and the cylinder is the compression chamber **C**. The heat switchers are set at the extremities of the variable volume chambers: the heater (**H**) at the end of the expanding room; the cooler (**K**) at the end of the compression room. In order to increase the thermo efficiency between the two heat switchers is placed the regenerator (**R**). The regenerator is a heat accumulator which works in the following way: takes over the heat from the motor agent when it flows towards the cooler (the cold area); gives up heat to the motor agent when it flows towards the heater (the hot zone). On the rods of the pistons (**PM**) and (**PC**) are set the pistons from the hydraulic cylinders (**CH1**) and (**CH2**). The movement of the pistons is coordinated by an automatic command and control system made of: command distributors, pressure sensors etc.

At the *beta generators* the two cylinders are set coaxially and inside the pistons have an alternative-linear movement (*fig. 2 b*). To make a calculation on the thermo-dynamic parameters of the generator we'll make the following simplifying assumptions: the motor fluid is considered a perfect gas (nitrogen, helium); the instantaneous pressure is the uniform in all chambers; the temperature of the agent from the heat switchers are considered constant; the evolution of the motor fluid from the expanding chamber **E** and the compression chamber **C** may be considered isothermal (*Schmidt* model) or adiabatic (*Finkelstein* model).



a) Alpha generator



b) Beta generator

Figure 2: Energy generators scheme

The diagram of the calculation model is based on the following simplifying assumptions (fig. 3): the generator is made by five spaces (the compression room, cooler, regenerator, heater and the expanding chamber) linked in series, separated by *control surfaces*; each space interact between each other through *heat exchange* and *mass exchange*, and with the external surroundings through *heat* and *mechanic work* exchange; the kinetic energy of the motor agent is negligible, the dynamic gas losses and the gas losses due to imperfect tightness.

Through the control surfaces a heat and mass control takes place. The heat flow exchanged through the control surface depends on the gas flow  $\dot{m}$  and gas temperature. For example, the heat flow transmitted through the control surface between chambers **E** and **H** is:  $\dot{Q}_{EH} = c_p \cdot \dot{m}_{EH} \cdot T_{EH}$ , if:  $\dot{m}_{EH} > 0$  (the flow is from  $E \rightarrow H$ )  $T_{EH} = T_E$ ;  $\dot{m}_{EH} < 0$  (the flow is from  $H \rightarrow E$ )  $T_{EH} = T_H$ . For the calculation of the thermodynamic parameters we apply: the equation of the mass balance; the equation of the energetic balance; and the state equation of the perfect gas. The variability functions of the chamber volume **E** and **C** are determined through applying the theory of kinetic energy. Other details regarding the calculation of the thermodynamic parameters can be found in the work [1].

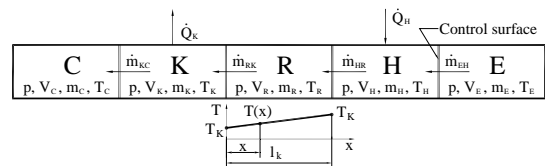


Figure 3: Scheme for model calculation

#### 4. THE HOT AND COLD WATER SOURCE

Supplying the heater with hot water and the cooler with cold water is made intermittently, with the help of some hydrophores. The heating of water from the hydrophore is made through the help of a heat exchanger, from the thermal water, or from the primary fluid (melt salts, special organic fluids) of the solar collector. The hot water pressure from the hydrophore must be powerful enough, not to be evaporated.

#### 5. CONCLUSIONS

The electro mechanic conversion of the thermo energy from thermal waters and solar energy can be made in the most favorable way using a system made of a motor having a Stirling type thermo cycle. The motor works quietly, is not polluting, and uses free and inexhaustible energy (solar energy). The new one raided thermo motor has the following advantages compared to the classical Stirling: simple design; works automatically;

doesn't need a starting system; the thermo cycle takes place in optimal conditions, the pistons have intermittent motion not a continuous one like in the classic motor with motor mechanism. The thermo efficiency of the motor rises if the heating water temperature rises. As a conclusion, it is advantageous to use a solar collector with a great ratio of concentration which can reach temperatures of 400-550 °C. It is recommended the research of conversion systems suggested in the work.

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