A NEW DESIGN OF ENERGETIC UNIT FOR SHIPS

Vladimír Hlavňa

University of Žilina
ul. Univerzitná 1, 010 26 Žilina, Slovak Republic
tel.: +421 41 513 2670, fax: +421 41 653016
e-mail: vladimir.hlavna@fstroj.utc.sk

Abstract

A new possibility of utilization of ICE cooling medium thermal capacity is its connection with the independent sorption cooling equipment by thermal pipe. Such a configuration avoids the use of a utilizable thermal gradient. This disadvantage of connection of the classical combustion engine with sorption cooling equipment is solved by a cooling internal combustion engine. Its basis lies in the fact that the chambers of the cooling jacket are simultaneously generator of the sorption cooling equipment. The classical engine becomes the sorption cooling equipment. Such an engine can be used for combined generation of electric energy, heat and cold. Cold can be used for the cooling of an engine charging air and for air conditioning of ships equipped with such an engine and cooling of food.

Keywords: *non-conventional energetic unit, cooling combustion engine, more efficient utilization of fuel energy*

1. Introduction

At a constructional realization of a ship it is necessary to deal with individual constructional parts so that the vessel can meet the requirements for safe and comfortable voyage and can feature required navigation and maneuvering abilities under varying loading conditions caused by outer influences.

Important parts of the vessel to be mentioned here are aggregates serving for driving and stabilization and as well as aggregates providing necessary kinds of energy both on board and below. The required kinds of energy (mechanical, electric, thermal, including cold) can be provided by means of the combustion engine in cooperation with suitable equipment. All kinds of energy can be distributed both on board and below. When secondary energies provided by the combustion engine are utilized in an efficient way, we can speak about an advantageous balanced utilization as well as about the aim to maximize the utilization of the fuel carried by the vessel. This fact consequently influences the assessment of the vessel from the point of view of its shipping weight and load capacity from which the total shipping capacity of the vessel results.

2. A new design of energetic unit

A new design of the energetic unit can provide the required kinds of energy, e. g. according to the scheme shown in Fig. 1. The system itself equipped with an appropriate control has to be able to distinguish priorities in the energy distribution. The energetic unit consists of the combustion engine being the primary source of energy for secondary cooperating devices. The devices use for their operation components of outer thermal balance of the combustion engine. An electro generator is used for transformation of mechanical energy into electric energy. Heat can be obtained from exhaust gases by means of an exhaust gases – water exchanger. Cold can be obtained from the thermal balance component which characterizes the combustion engine cooling system. Transformation of heat into cold is carried out by means of thermo compression. Thermo compression can be carried out indirectly, again, by means of an exchanger, or directly within the combustion engine block. For thermo compression to be carried out it is necessary to equip the combustion engine circuit with the sorption cooling system elements and to optimize the construction by creating conditions for its realization. The working substance of the sorption system flows directly within the combustion engine block. This block becomes the thermo generator of the cooling system based on the absorption principle [1].

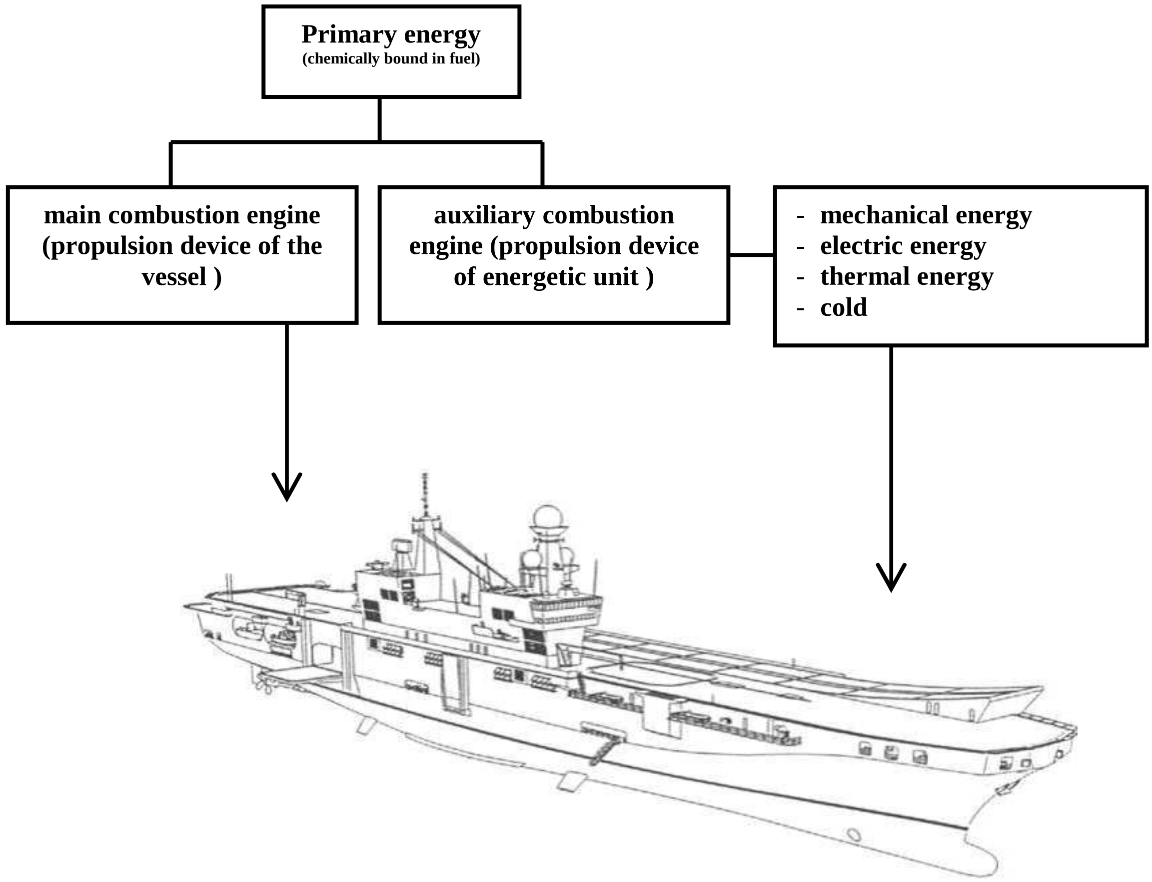

Fig. 1. Energetically provided vessel

For energetic assessment of the system it is possible to give the factor of thermal balance utilization (VTB) of the combustion engine:

$$VTB = \frac{Q_{VYF}\eta_{TE} + Q_{CH}\eta_{CH} + Q_E\eta_{EL}}{Q_P}, \quad (1)$$

where:

Q_P – energy contained in the consumed fuel,
Q_{VYF} – energy of exhaust gases,
η_{TE} – efficiency of Q_{VYF} transformation into usable heat,
Q_{CH} – energy taken by the combustion engine cooling,
η_{CH} – efficiency of Q_{CH} transformation into cooling output,
Q_E – component characterizing the output on the crankshaft,
η_{CH} – efficiency of transformation Q_E into electric output.

The scheme of the new design of the energetic unit can be seen in Fig. 2 [1, 2], where the auxiliary combustion engine is the primary source of energy (Fig. 1).

The energetic unit scheme consists of a set of exchangers, regulating and control elements and measuring elements.

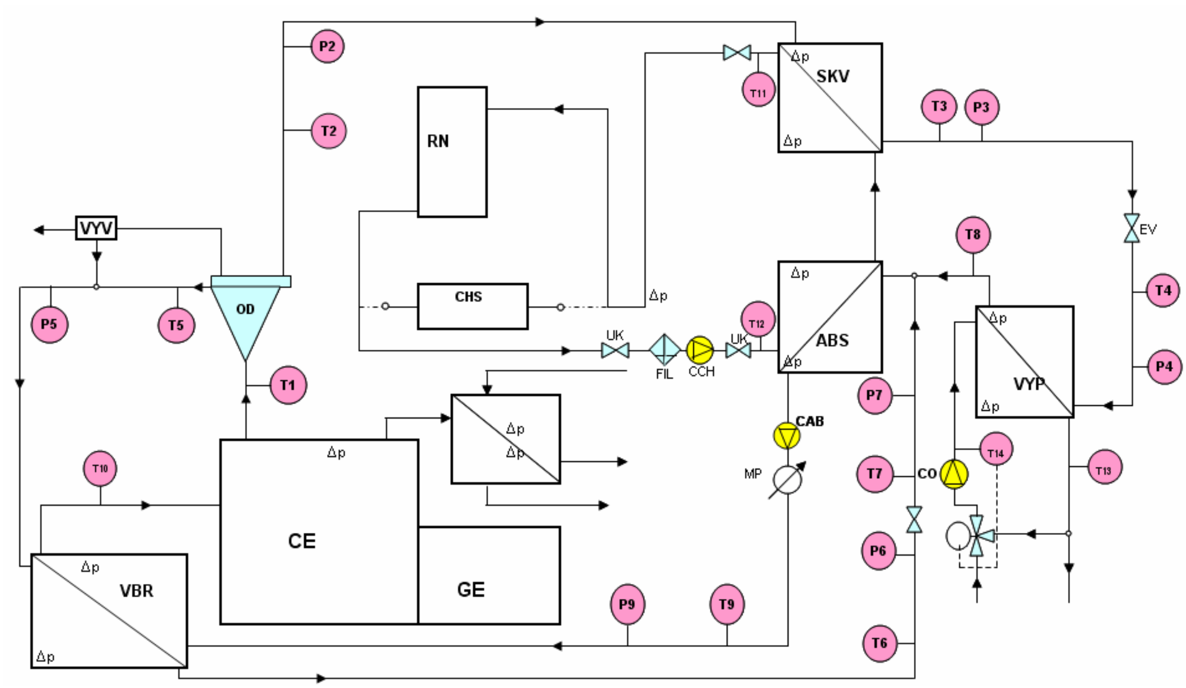

Fig. 2. Scheme of energetic unit. Exchangers: OD- evaporator, VBR- economizer, VYV- vacuum air pump, RN-retainer, CHS- cooler in which heat from sorption circle is obtained, CE – combustion engine, GE – electro generator, SKV- liquefier, ABS – absorber, VYP – evaporator, cooling of the coolant or environment and exchanger for heat from exhaust gases; Regulating and control elements: UK – closing valve, FIL – filter, CCH – circulating pump, CAB – regulating and circulating pump, MP – induction flow meter, CO – circulating pump, EV – expansion valve; Measuring elements: temperatures T_{1-9}, pressure P_{1-9}

When taking into consideration losses and efficiencies of individual circuits, the energetic unit of this type is able to make use of 86 % of primary fuel energy (energetic balance will be dealt with in more detail further). Fig. 3 presents a virtual design of an experimental non-conventional energetic unit. At present it is possible to present also a real laboratory model of the non-conventional energetic unit – Fig. 4.

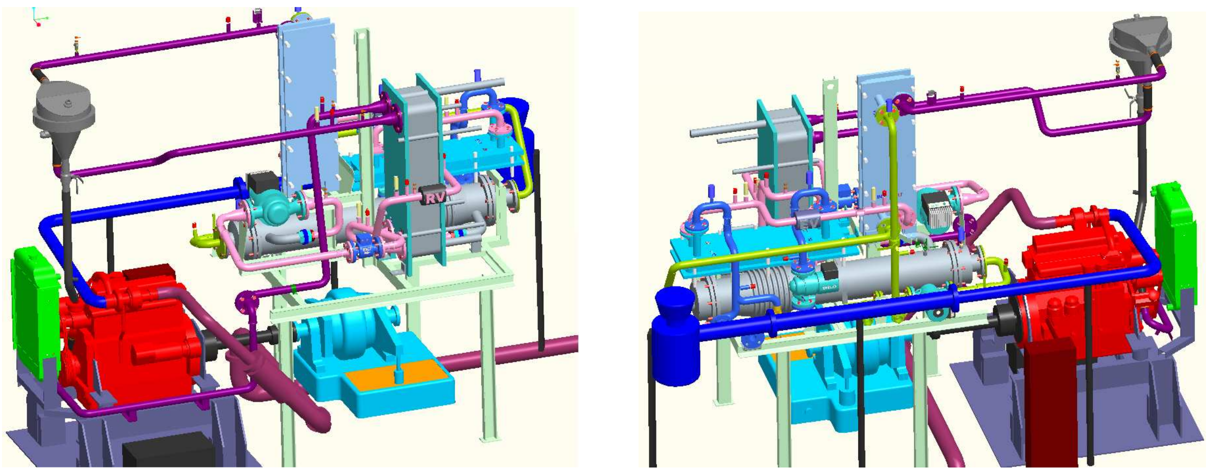

Fig. 3. Virtual energetic unit

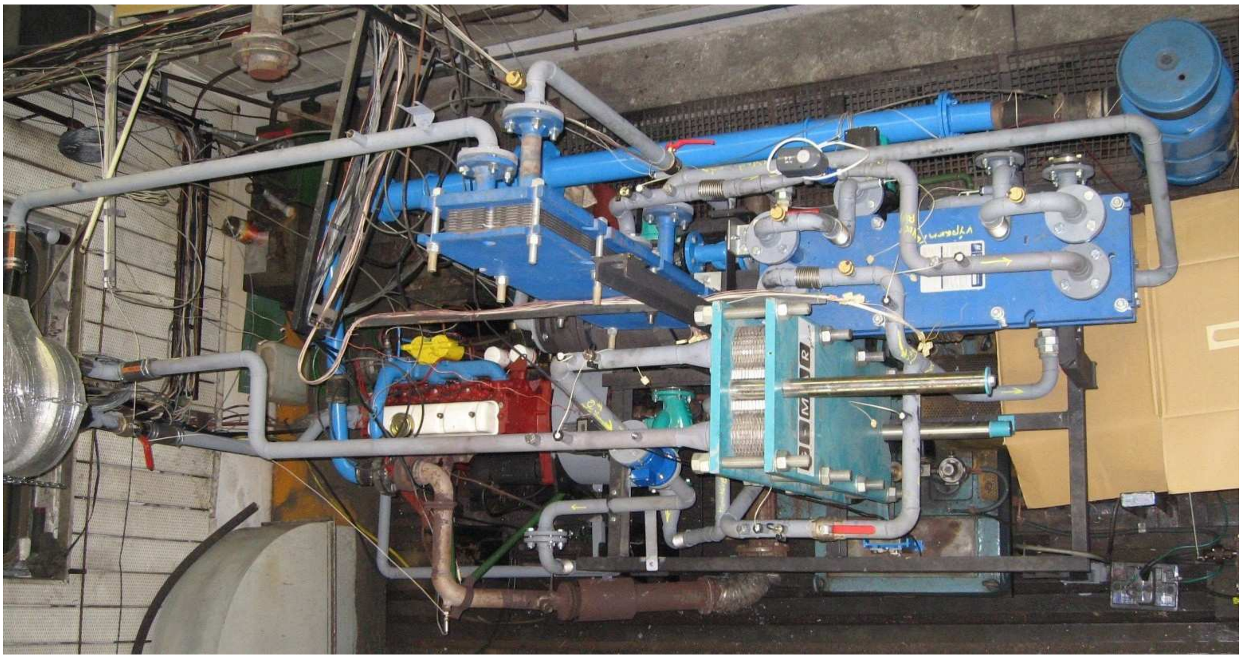

Fig. 4. Real construction of energetic unit

3. Conclusion

Output parameters of the energetic unit circuits (thermal circuit, circuit of the cooling and electric systems) are related to the engine output and its outer thermal balance. Another factor added to the above parameters is the efficiency of the physical principle of thermo compression within exactly stipulated pressure conditions, which exerts a substantial impact on the attainable cooling output usable on the vessel. This fact is assessed and observed by means of evaporation efficiency in the area of the evaporator. The output parameters of the non-conventional energetic unit are influenced also by its construction which is observed and assessed by means of its constructional efficiency.

So far we have carried out basic research of the equipment and by means of experiments we have verified basic axioms of operation within the given pressure and temperature conditions.

A direct use of the combustion engine in the circuit to provide cold represents a new attitude in the energetic unit realization. The objective is to achieve a more efficient utilization of the fuel primary energy, in this case, fuel carried by the vessel.

References

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