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Journal Name:	Journal of Energy Research and Reviews
Manuscript Number:	**Ms_JENRR_48514**
Title of the Manuscript:	**Efficient thermal cycle undergoing adiabatic contraction based work by releasing heat**
Type of the Article	

General guideline for Peer Review process:

This journal's peer review policy states that **NO** manuscript should be rejected only on the basis of '**lack of Novelty'**, provided the manuscript is scientifically robust and technically sound.
To know the complete guideline for Peer Review process, reviewers are requested to visit this link:

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PART 1: Review Comments

<table>
<tr><td></td><td>Reviewer's comment</td><td>Author's comment (if agreed with reviewer, correct the manuscript and highlight that part in the manuscript. It is mandatory that authors should write his/her feedback here)</td></tr>
<tr><td><u>Compulsory</u> REVISION comments</td><td>The work is interesting both from a scientific and practical point of view. Scientific interest is it shows that there are schemes of thermal machines that have a coefficient of performance greater than the Carnot cycle. The use of such schemes is of practical interest to reduce heat losses in modern industry.

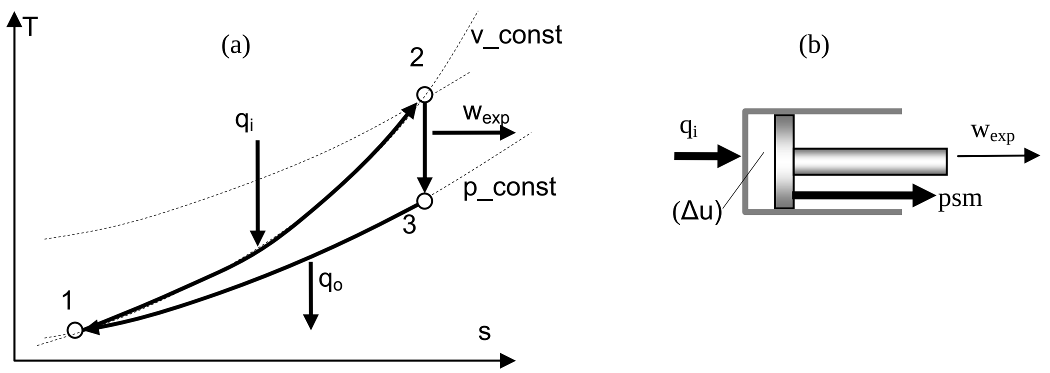
However, the work has a significant flaw. According to equation (12), the considered scheme of the heat machine violates the principle of energy conservation. This conclusion cannot be made without a detailed description of the thermodynamic processes of the experimental device. Moreover, the authors have an experimental device on which the described effects are observed. To avoid contradiction with the law of energy conservation, a detailed description of this device is necessary. Then the balance equations of energy transfer from external sources and exchange processes inside the plant should be written. As a result, the total energy balance will be obtained. The resulting equations will also include exchange processes that are not taken into account in equations (1) – (7). The result should be not only the efficiency of the thermal machine circuit, but also it will be possible to explain by what processes the efficiency of the heat machine in question exceeds the efficiency of the Carnot cycle. In General, such an analysis is difficult to carry out. We can recommend the authors to describe in detail the energy balance for the device of figure 3. Without such a change in the theoretical part of the work, I can not recommend the article for publication.</td><td>Replay to reviewer:
The authors find that the reviewer comments are very reasonable, interesting and useful.
The reviewer kindly comments that according to equation (12), the considered scheme of the heat machine violates the principle of energy conservation. In terms of the conversion of thermal energy to mechanical energy (work), the evidence based on daily experimental observation, axiomatic and therefore irrefutable, for experts in the field is summarized in the following two concept descriptions:
The conversion of thermal energy (heat) to mechanical energy (work) by means of a closed processes based thermal cycle (trilateral cycle) can be carried out by:
a), Trilateral cycle according to Fig. 1-rev
-- transformation 1-2, Isochoric heat addition q_i,
-- transformation 2-3, partial conversion of added heat q_i into mechanical work w_{exp} by adiabatic expansion of a thermal working fluid (WF), so that the mechanical work is the difference between the added heat q_i and the rejected heat q_o.
-- transformation 3-1, inherent heat rejection q_o (kelvin-Planck: two heat reservoirs, high and low temperature are required), so that the mechanical work w_{exp} due to the WF expansion is the difference between added input heat q_i and rejected output heat q_o. (conventional or classical thermodynamics)
The first principle for the cycle (with Δu=0) depicted in Fig. 1-rev yields
$$q_i - q_o - w_{\exp} = \Delta u = 0$$
$$q_i - q_o = w_{\exp} \qquad 1 \qquad (1)$$


Fig. 1-rev
b), Trilateral cycle according to Fig. 2-rev
-- transformation 1-2, isobaric heat replenishment $q_{r,}$
-- transformation 2-3, Isochoric heat extraction (q_e),
-- transformation 3-1, a fraction of heat extracted q_e is converted into useful mechanical work w_{cont} by the adiabatic contraction of the WF so that the mechanical work is the difference between the extracted heat q_e and the replenishment heat q_r.</td></tr>
</table>

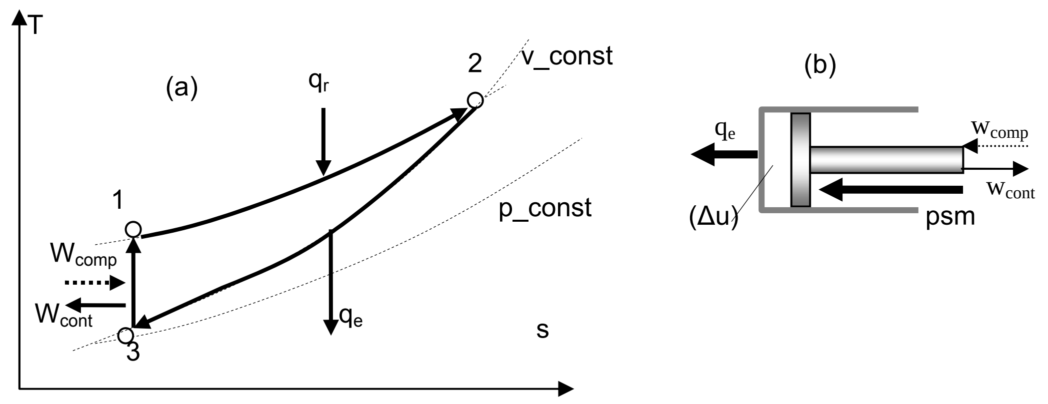


Fig. 2-rev

The first principle for the cycle (with Δu=0) depicted in Fig. 2-rev yields

$$q_r - q_e + w_{comp} = \Delta u = 0$$

$$q_r - q_e = -w_{comp} \qquad (2)$$

that is, in a trilateral cycle the difference between input heat added heat (replenished heat) and output heat (extracted heat) is a compression work w_{comp} performed by extracting heat from a working fluid to a heat sink.

However, the real facts based on experimental evidence consists in that the difference between replenishment heat q_r and extracted heat q_e, in a trilateral cycle that performs work by extracting heat, is an output useful work w_{cont} obtained by contraction based compression of the working fluid, so that $q_r - q_e = w_{cont}$ because it is an output useful work w_{cont}, described as the contraction based compression work which can be expressed as

$$|q_r - q_e| = w_{cont} \qquad (3)$$

and is characterized by the fact that both the useful output work and the increase of internal energy take place simultaneously.

Note that the transformation 3-1 in Fig 2-rev consist of doing useful mechanical work and increasing internal energy simultaneously.

The fact of obtaining useful work while increasing the internal energy is not a typical situation in heat-work interaction tasks.

Discussion:

Therefore, considering a quadrilateral cycle composed by two trilateral cycles, the total work due to both trilateral cycles based on the observed facts is

$$w_{\exp} + w_{cont} = q_i - q_o + |q_r - q_e| \qquad (4)$$

Taking into account that both trilateral cycles are equivalent to a quadrilateral cycle, in which the heats q_o and q_r used in the trilateral cycles do not exists, from (4) follows that

$$w_{\exp} + w_{cont} = q_i - q_e,$$

which ***contradicts*** the energy balance of any conventional thermal cycle based on adding and rejecting heat, such as $q_i - q_o = w_{\exp}$

Each one of both individual equations (1) and (2) comply strictly the principle of energy conservation (as it has been assumed so far) so that fulfils the first principle of the thermodynamics.

We have to get used to not confusing (or differentiating) between the concepts of thermal cycles that consist of adding heat to a process, which involves performing mechanical work associated with the inherent *rejection* of heat, and extracting heat from a process that involves carrying out work by contraction with inherent heat absorption. Both cycles satisfy the principle of conservation of energy and consequently the first principle. When these two

		single-effect thermal cycles (based respectively in addition and extraction of heat) are associated in a single double-effect cycle, two types of useful work is obtained at the economic cost of a single added heat, (if and only if the cost of extracting heat is zero). The reviewer expressed also his interesting opinion with regard to "an experimental device on which the described effects are observed. To avoid contradiction with the law of energy conservation, a detailed description of this device is necessary. Then the balance equations of energy transfer from external sources and exchange processes inside the plant should be written. As a result, the total energy balance will be obtained. The resulting equations will also include exchange processes that are not taken into account in equations (1) – (7). The result should be not only the efficiency of the thermal machine circuit, but also it will be possible to explain by what processes the efficiency of the heat machine in question exceeds the efficiency of the Carnot cycle". The objective of an experimental device is just a proof of concept, which consists of a qualitative instead of quantitative proof of concept. Thus, the experimental device has been constructed to demonstrate that: a.- efficient heat transfer is only possible by means of forced convection, so that a recirculating fan is required for every heat exchanger, which consumes some energy. b.- useful work is obtained by adiabatic expansion, by previously heating a working fluid by an isochoric process (can be heated also by an isobaric process or a polytropic process) c.- useful work is obtained by adiabatic contraction based compression, by previously extracting heat from a working fluid by an isochoric process (can be heated also by an isobaric process or a polytropic process) As consequence of the evidence provided by experimental observations, these real facts cannot be refuted. However, it must be admitted that some consensus about the observed facts is obviously necessary among scientific, researcher and technicians' communities. With regard to reviewer comments "recommend the authors to describe in detail the energy balance for the device of figure 3". The cycle computation is performed and represented in tables 4 for a single acting cylinder which is similar to that of the double acting cylinder, and in table 5 for a double acting cylinder. This case study is patented with application number 201700181, and publication number 2 680 043, of the University of A Coruna, Spain. http://consultas2.oepm.es/InvenesWeb/faces/busquedaInternet.jsp;jsessionid=JLihEKvHpFyU0xqE63TE4517.srvvarsovia2; All technology concerning the thermal cycles characterised by doing work by extracting heat is, patented. About 7 patents exists about this topic. However, an extended study in order to compare the results with Carnot factor considering the cycle analysis through the balance and performance computation for several top temperatures between 350 to 700 K and undergoing a bottom temperature of 300 K is added and represented in Table 4. As consequence, the analysis of results will consider the study.
Minor REVISION comments		
Optional/General comments		

PART 2:

	Reviewer's comment	**Author's comment** *(if agreed with reviewer, correct the manuscript and highlight that part in the manuscript. It is mandatory that authors should write his/her feedback here)*
Are there ethical issues in this manuscript?	*(If yes, Kindly please write down the ethical issues here in details)*	