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Анатичук Л.І.

Анатичук Л.І., *акад. НАН України*[1,2]
Кузь Р.В., *канд. фіз.-мат. наук*[1,2]

[1]Інститут термоелектрики НАН і МОН України,
вул. Науки, 1, Чернівці, 58029, Україна;
e-mail: anatych@gmail.com;
[2]Чернівецький національний університет
ім. Юрія Федьковича, вул. Коцюбинського 2,
Чернівці, 58000, Україна

Кузь Р.В.

ПРО ОСОБЛИВОСТІ РОЗВИТКУ РОБІТ ПО СТВОРЕННЮ ТЕРМОЕЛЕКТРИЧНИХ РЕКУПЕРАТОРІВДЛЯ ТРАНСПОРТНИХ ЗАСОБІВ

У роботі проведено аналіз публікацій, патентів, доповідей на наукових конференціях, що стосуються створення термоелектричних рекуператорів для утилізації відходів тепла від трансопртних засобів. Зроблено висновки про перспективи подальшого розвитку таких досліджень. Бібл. 143, рис. 5.

Ключові слова: термоелектричний генератор, вихлопний газ, утилізація тепла.

Вступ

Загальна характеристика проблеми.

Використання термоелектрики для утилізації відходів тепла з метою отримання електричної енергії було і залишається предметом інтересу спеціалістів, що займаються термоелектрикою, протягом останніх майже трьох десятиріч. Серед джерел відходів тепла значне місце займають двигуни внутрішнього згорання (ДВЗ) трансопртних засобів. Тому така зацікавленість є зрозумілою, оскільки, зважаючи на ККД двигунів внутрішнього згорання, біля 2/3 теплової енергії (рис. 1), що отримується від спалювання бензину чи дизельного палива, віддається оточуючому середовищу, сприяючи термальному забрудненню нашої планети.

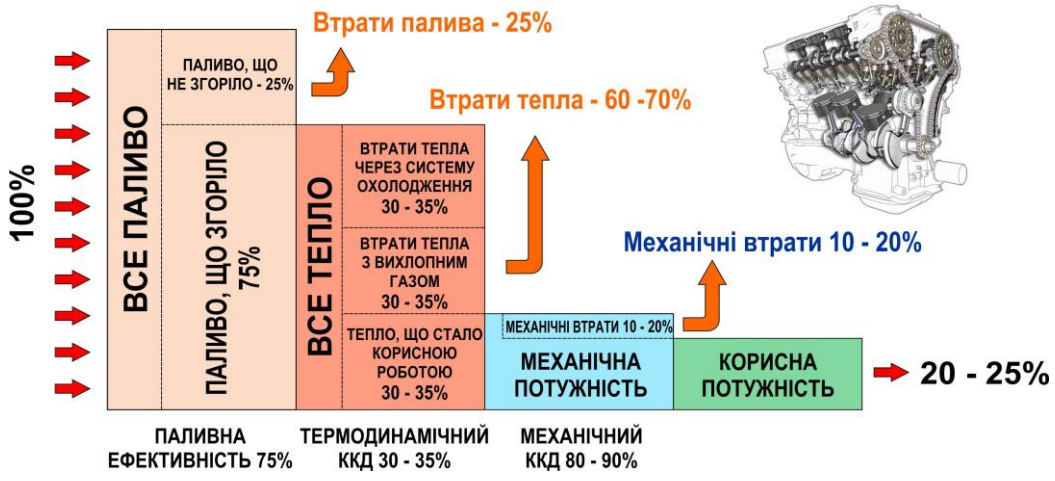

Рис. 1. Баланс енергії в двигуні внутрішнього згорання.

Метою даної роботи є аналіз досягнень і перспектив у галузі створення термоелектричних рекуператорів для трансопртних засобів.

Розвиток робіт по створенню термоелектричних генераторів (ТЕГ) для транспортних засобів

Географія наукових досліджень і розробок ТЕГ для транспортних засобів охоплює більшість країн, де ведуться дослідження з термоелектрики. Результатам таких робіт було присвячено більше сотні доповідей на багатьох конференціях (рис. 2).

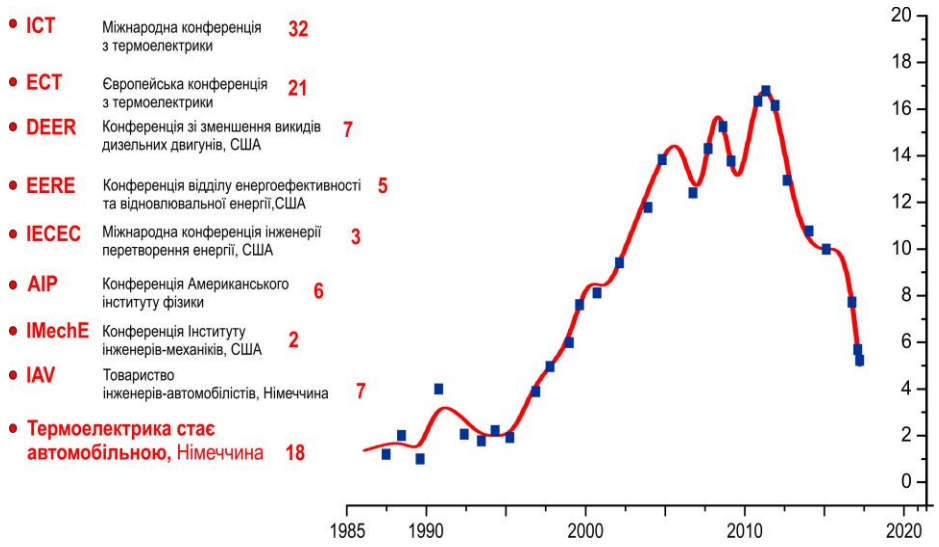

Рис. 2. Динаміка росту кількості доповідей на міжнародних конференціях, що присвячені ТЕГ для трансопртних засобів [1 - 52].

Слід при цьому відмітити, що пік досліджень таких термоелектричних генераторів припадає на 2010 роки. Після цього спостерігається зменшення кількості таких робіт. Аналогічні залежності спостерігаються і у кількості публікацій. Їх максимум також припадає на 2010 роки зі згортанням активності у подальші роки (Рис. 3).

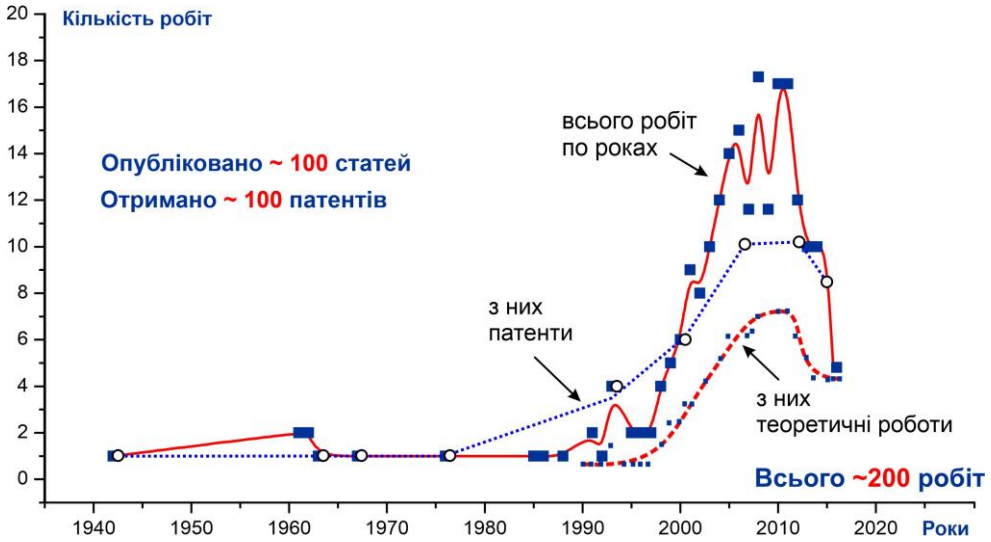

Рис. 3. Динаміка активності досліджень ТЕГ для транспортних засобів [53 - 148].

Стрімке зростання кількості робіт, починаючи у 1990-х роках і закінчуючи 2010-ми, були результатом сподівань на впровадження автомобільних термоелектричних генераторів. Однак, у цей період у більшості випадків зразки генераторів розроблялися без належного теоретичного обгрунтування, просто виходячи з досвіду створення термогенераторів для інших цілей – космічних, автономних наземних, підводних та інше. Було опубліковано біля сотні статей і отримано приблизно таку ж кількість патентів. Результатом таких зусиль було зростання потужності генераторів для трансопртних засобів до 1 кВт (рис. 4). Зростав і ККД (рис. 5), але у величинах, що у 8 - 10 разів були меншими, ніж очікувані.

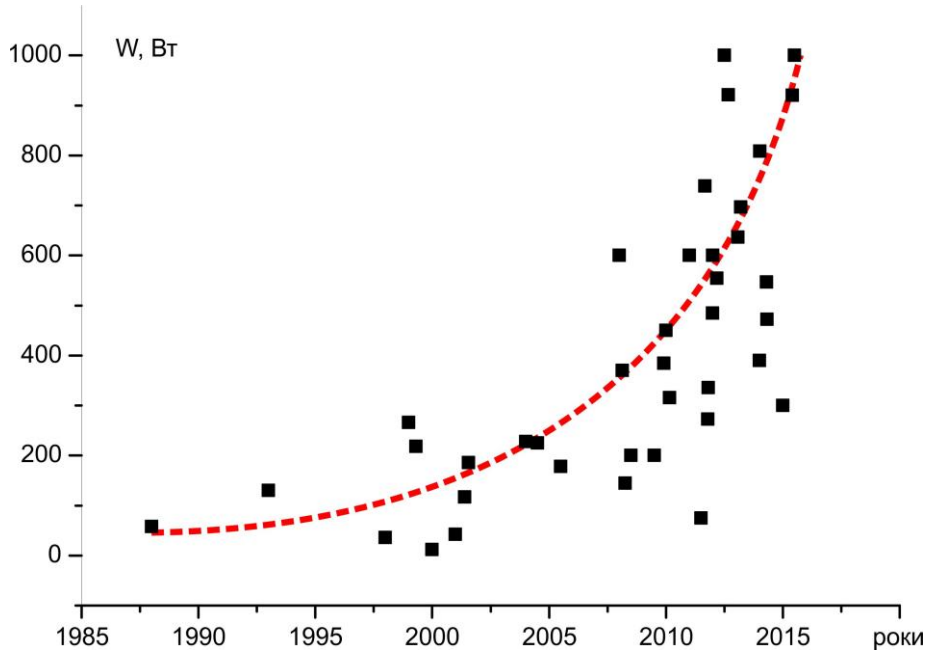

Рис. 4. Зростання потужності ТЕГ для транспортних засобів.

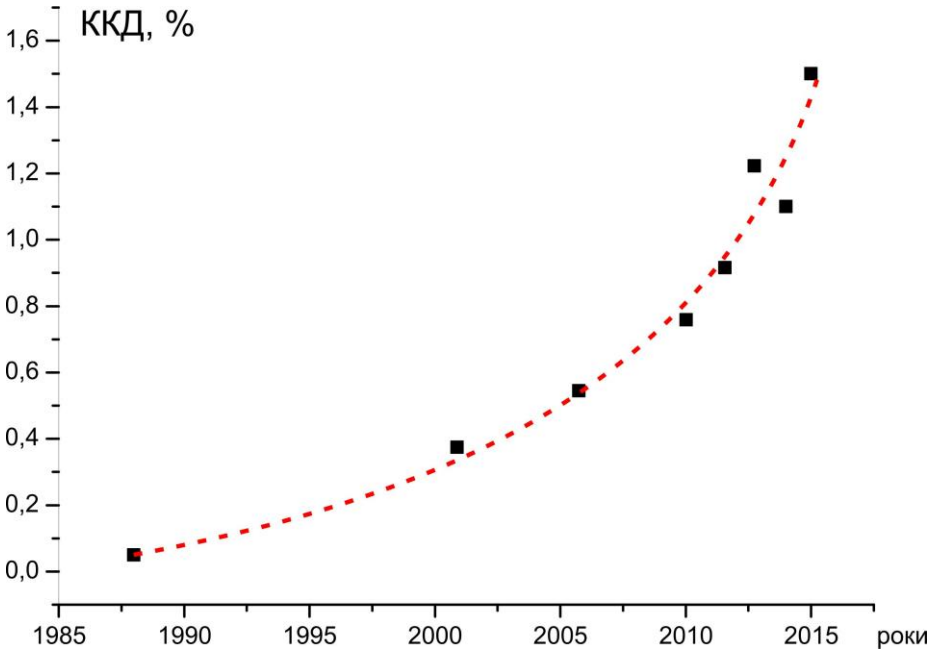

Рис. 5. Зростання ККД ТЕГ для транспортних засобів.

І все ж отримані результати дали важливу інформації про можливості використання термогенераторів для утилізації відходів тепла від транспортних засобів. Розглянемо основні з них.

1. Слід визнати, що розробка генераторів для автомобілів є однією з найбільш складних, виходячи з вимог до них і їх властивтей:
   - обмеження по вазі і об'єму у зв'язку з їх дефіцитом, особливо на легкових автомобілях;
   - підвищені вимоги до транспортної тряски;
   - значна залежність теплової потужності від часу, що приводить до підвищених вимог до циклічної теплової стійкостігенераторів;
   - відсутність стабільності у електричних напругах та потужностях, що вимагає використання спеціальних електронних засобів для подолання цих недоліків;
   - не ефективне використання можливостей генераторів у зв'язку з їх переважною роботою у режимах, далеких від максимальної потужності і ККД;
   - низькі значення ККД, що обумовлюють високу вартість елктричної енергії, отриманої від генераторів;
   - обмеження у масштабних використаннях генераторів, обумовлених недостатньою кількістю телуру;
   - проблеми відводу тепла від генераторів та інші проблеми.
2. Більш перспективними виглядають використання термогенераторів у інших не автомобільних транспортних засобах – тепловозах, літаках, та особливо у водному транспорті, де наведені вище проблеми та обмеження є менш значними.
3. В цілому прогрес у термоелектриці залишає мрію про створення термогенераторів для странспортних засобів не безнадійною. Ентузіасти цієї справи сподіваються, що при здешевленні вартості генераторів у 3 -5 разів та забезпеченні інших специфічних їх властивостей виникнуть умови, перспективні для їх промислового використання.

Такі результати роблять ідею створення термоелектричних генераторів для серійного виробництва мало привабливою, тому багато з розробників відмовилися від подальших їх розробок. До того ж теоретичні роботи привели до розуміння складності у реалізації ідеї термоелектричних генераторів для автомобілів, що і стало причиною згортання робіт у цьому напрямку.

Виходячи з таких результатів є важливим в цілому розглянути, на скільки все ж перспективними є подальші дослідження у цьому напрямку і які реальні результати слід при цьому очікувати.

Висновки

1. Неоптимальне проведення досліджень і розробок, при якому чисельні експериментальні спроби здійснювалися без належних теоретичних обґрунтувань привели до надмірних витрат ресурсів і часу.
2. Використання ТЕГ на автомобілях є одним з найбільш складних застосувань термоелектрики. В першу чергу завдяки нестаціонарному джерелу тепла, ударним та вібраційним навантаженням, обмеженням у габаритах та вазі.
3. Необхідний новий підхід до розгляду термоелектричних генераторів для транспортних засобів, де термоелектричний генератор і двигун внутрішнього згорання розглядаються у сукупності.

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Анатычук Л.И., *акад. НАН Украины*[1,2]
Кузь Р.В., *канд. физ.-мат. наук*[1,2]

[1]Институт термоэлектричества НАН и МОН Украины, ул. Науки, 1,
Черновцы, 58029, Украина, *e–mail: anatych@gmail.com;*
[2]Черновицкий национальный университет
им. Юрия Федьковича, ул. Коцюбинского, 2,
Черновцы, 58012, Украина

О ОСОБЕННОСТИ РАЗВИТИЯ РАБОТ ПО СОЗДАНИЮ ТЕРМОЭЛЕКТРИЧЕСКИХ РЕКУПЕРАТОРА ДЛЯ ТРАНСПОРТНЫХ СРЕДСТВ

В работе проведен анализ публикаций, патентов, докладов на научных конференциях, касающихся создания термоэлектрических рекуператоров для утилизации отходов тепла от трансопртних средств. Сделаны выводы о перспективах дальнейшего развития таких исследований. Библ. 143, рис. 5.
Ключевые слова: термоэлектрический генератор, выхлопной газ, утилизация тепла.

L.I. Anatychuk *acad. National Academy of Sciences of Ukraine*[1,2]
R.V. Kuz *cand. phys. - math. Sciences*[1,2]

[1]Institute of Thermoelectricity of the NAS and MES of Ukraine,
1, Nauky str., Chernivtsi, 58029, Ukraine;
[2]Yu.Fedkovych Chernivtsi National University,
2, Kotsiubynskyi str., Chernivtsi, 58000, Ukraine
e-mail: anatych@gmail.com

ABOUT THE PECULIARITIES OF PROGRESS IN THE WORKS TO CREATE THERMOELECTRIC RECUPERATORS FOR VEHICLES

The analysis of publications, patents, reports at scientific conferences related to the creation of thermoelectric recuperators for the utilization of heat from vehicles is carried out. Conclusions are made on the prospects for further development of such studies. Bibl. 143, Fig. 5.
Key words: thermoelectric generator, exhaust gas, heat recovery.

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