TERMOELECTRICAL MATERIALS, ELECTROGENERATED COOLING SYSTEM WITH THE POWERFUL SKELETON.

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ABSTRACT

It is considered developed consolidated materials for thermoelements (TE) and designs TB, allowing to provide an opportunity creation enough the big efforts of pressing thermocontact plane of hot jonts to the basis of thermalexchange systems.It is provided the achievement of minimally possible magnitude of thermal resistance on the most intensive in the thermal meaning the plane of contact. The efforts of pressing become isolated in the assembly device (skeleton); branches of thermoelements (BTE) appear mechanically unloaded.

Keywords: elektrogenerated, thermoelements, technology, termoelements, electroisolate, thermoelectric alloys, thermoelectric batteries.

I. INTRODUCTION

In the beginning we shall briefly stop on the basic modern problems of development of materials for solid-state cooling and thermoelectric electrogenerating. The following questions are most actual:

1. Technology - synthesis, reception of samples by ceramic-metal way and hot pressing, and cultivation of crystals by methods:Chokhralsky, Brijmen and the vertical directed crystallization;
2. Revealing heterogeneous in multicomponent firm solutions on a basis chalkogenid bismuth and antimony;
3. The structural changes influencing on efficiency BTE;
4. Application of artificial - anisotropic crystals with various layers;
5. An opportunity of reception highly effective film nanostructucal termoelements .

The most economical and effective alloys in our opinion are methods metalceramics (cold and hot pressing) and hot pressing . From directed crystals (NK) the samples having thermoelectric efficiency (also are widely used at T=250-350ºK) $_{Zav} \approx 3 \cdot 10^{-3}\,k^{-1}$. High speed of cultivation V = (3-5) sm / hour at quantity{*amount*} of ampoules (Ø 14-15 mm) in installation not less than 30 pieces allows to receive enough of substance for halfindustrial scale.

It is necessary to note perspectivity thin films chalkonid bismuth and antimony and their multilayered heterostructures . It is possible relate with those also epitaxil films $(Bi, Sb)_2 (Te, Se)_3$ with high values of parameter of capacity $\eta = \alpha^2 \cdot \sigma$ (where α -termoeds, σ - electroconductivity), brought up by a method of a hot wall and a method mollecular-beam epitaxy МБЕ. Authors [1] successfully use a chemical method (MOCVD) for reception thin textual layers of telluride of bismuth. According to [2] essential increase Z can be achieved in films with thickness in some constant lattices. Thin layers $(Bi, Sb)_2 (Te, Se)_3$ with thickness or the size of crystal grains at 50-20 nm can possess the essentially greater size Z, than corresponding monocrystals [3]. Uniformity on length of alloys and thermoelectric efficiency $Z_p \geq 3{,}3 \cdot 10^{-3}\,k^{-1}$ was guaranteed and $Z_n \geq 3{,}0 \cdot 10^{-3}\,k^{-1}$ (thus for images of p-type thermoelectric parameters were the following: $\alpha_p = +210\,{}^{\mu kv}/{}_{^0k}$, $\sigma_p = 1050 om^{-1} см^{-1}$); For p-type $\alpha_n = 205\,{}^{\mu kv}/{}_{^0k}$, $\sigma_n = 1000 om^{-1} см^{-1}$). Received ВТЭ did not concede to known modern development [2, 4-6]. Crystals VTB received by such way have been applied in the thermoelectric batteries developed by us with strengthening skeleton.

Development of the optimized thermoelectric batteries with strengthening a skeleton.

II. MAIN TEXT

In this part of work bringing results of development of thermoelectric batteries with effective system thermofault from with hot of sodered joint TB. At researches it was necessary to provide conditions of reception of the maximal difference of temperatures, application of the elementary - inexpensive materials and technological methods of optimization of all system. The primary goal has been connected to the undertaken successful attempt of creation TEB with the raised{*increased*} mechanical durability, reliability and operation working in severe constraints. Its{*her*} design should provide unloading TE and is especial them спаев from mechanical pressure{*voltage*} and giving TB of necessary durability.

For performance of the specified conditions in design TEB the skeleton of rigidity from electro and thermoisolated materials, supplied can be stipulated by two dielectric payments.

The closest technically to achievable result is the design, containing TE, a power{*force*} skeleton as flat cassete with apertures for installation of elements and screws of fastening, the switching trunks rigidly connected to a skeleton and termoexchange system. On a surface of cassete , inverted to termoexchange system, sites of a layer of copper, under the form and the sizes corresponding to an arrangement of switching trunks are formed. Semi-conductor BTE are located in apertures cassete, and switching trunks are soldered simultaneously to a surface of elements and to close sites of a layer foiled textolite. After machining working surfaces TEB, it through electroisolated linings is established in the concrete converter on the basis thermoexchange systems.

Development of equipment from strong electroisolate materials.

For the decision of this problem skeleton TEB is made by us of an alloy with the high heat conductivity, covered with isolation from oxide aluminium. Besides on its side inverted to thermoexchange system, dredging for installation komutative trunks by depth, their equal thickness is executed. Such trunks can be made as plates with ledges.

The circuit of all system is given in figure (and, in, г, д). On fig. (а) it is submitted cassete of strong skeleton, on fig. 1 (б) its cutting on Ç-Ç, on fig. 1 (в) the switching trunk as a plate with ledges is represented, on fig. (г) skeleton TEB as cassete with the switching trunks pasted in it with thermoisolated cartridges is submitted, on fig. 1 (д) is given TEB in assembly (established in termoexchange system).

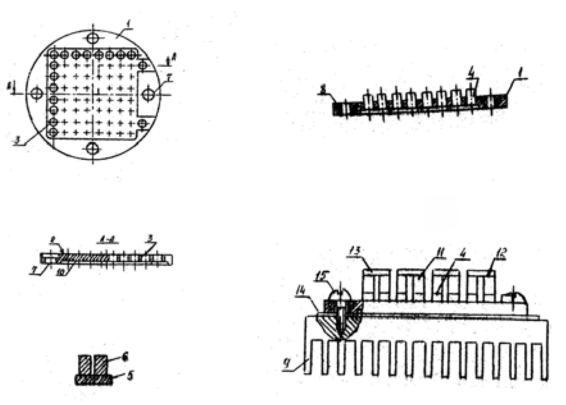

Fig. The circuit of a design thermoelectric batters.

So, the developed thermoelectric cooler (FEASIBILITY REPORT) includes the general strong powerful skeleton as flat cassete (1), covered thin electroisolated layer (2), with apertures (3) for dense landing{*planting*} switching plates hot спаев (4). On the party{*side*} касеты, inverted to a plane of contact to the basis thermoexchange systems (9), on the area borrowed{*occupied*} with plates (5), dredging (10) which depth is equal to thickness of plates (5) is executed. BTE (11) are soldered to end faces of ledges (6) and are connected on cold solderd joints (12) switching trunks (13). At installation TEB between the basis thermoexchange systems (9) and thermocontact flatness force contact the lining (14), and necessary effort of pressing for maintenance of an effective heat-conducting path with hot joints (4) is placed electroisolated at small thermal resistance achieved with the help of the screws (15) transmitting effort in the basis thermoexchange system (9) through cartridges (8) on cassete 1 and further on plates (5).

Operating mode TEB.

After installation ТЭВon the basis of termoexchange system (9) she connect systems with observance of polarity to a source of a direct current. Switching trunks (13) cold solderd joint (12) BTE (11) start to be cooled, and switching trunks hot joints (4), including plates (5) with ledges (6) - to be heated up. Allocated heat, first, is allocated{*removed*} in an environment through sites electroisolating a lining (14) located under plates (5). At presence enough effective heat exchange with an environment on system (9) and qualitative isolation of trunks (13) cold joints (12) on the last appear temperature , lowered concerning external temperature.

Features of manufacturing TEB

Cassete is made of special alloys of duralumin. Drilling of apertures in which making on the special adaptation - to "conductor". After that cassetек is exposed to anodizing. High adaptability to manufacture and reliability in conditions of significant mechanical influences (at T=300К) on TEB has allowed to design powerful skeletons from dielectric powders with the low heat conductivity, maintaining temperature up to 1000ºК. It has allowed to create electrogenerating TEB with hot side VTE up to 600К. In quality gluring compounds mixes (50 %) special pastes (it is possible to use and special epoxide pitch) and by strongly crushed powder from easy "ultraweighed" have been used. For the first TEB have been used BTE from alloys chalcogens bismuth and antimony with the raised{*increased*} concentration of carriers of a charge (and average value of parameters BTE: $\alpha = 165\ {}^{\mu kv}/_{{}^{0}k}$ and $\sigma = 2000 om^{-1} см^{-1}$, Zav ≈ $2{,}3 \cdot 10^{-3} \cdot 10^{-1}$ in an interval of temperatures 300-500ºК).

Though the designs developed by us and made all over the world are standard, the FEASIBILITY REPORT are used for active cooling computer processors, automobile refrigerators of low power - IK-detectors and in others thermostats of local cooling, nevertheless wide application in different areas of technics, in industrial and household refrigerators is limited. In opinion of the author [7] restriction of it is connected to two features commercial thermoelectrics. First, they cannot work at temperatures below 160K°, that does not allow to use semi-conductor thermoelectric alloys in a combination to superconducting elements (that complicates development superconductivity electronics). Second, even the best BTE have no parameter ZT <1. That thermoelectric BTE could be used in household refrigerators dimensionless criterion ZT should be not less than 2 at room temperature [8]. At achievement ZT=3 [9] efficiency of the thermoelectric device will be those, that present compressor refrigerating units can be everywhere superseded by thermoelectric batteries. Huge advantage BTE and TEB consists that they to not contain moving systems and harmful chemical coldagents. It means, that they are extremely important and ecologically safe [7].

III. CONCLUSION

The design of the thermoelectric battery for solid-state cooling and electrogenerating with the highly developed mechanical durability and reliability, working with pressing on working surfaces to the thermoexchange systems .is developed.

As a whole on the basis of selection of optimum power parameters BTE, by creation of reliable methods of switching TEB with concrete conditions of thermal interface of all design it was possible to design the thermoelectric converter maintaining high mechanical pressure.

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