Esik kazakh-turkish high school

"Development and Research of solar collector with Thermosiphon Circulation"

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Project purpose: To provide with heat and hot water supply of houses, small enterprises cheap and environmentally friendly energy.

- We offer the project for heat and hot water supply, to use hybrid system of heat supply "a solar collector + the thermal pump".
- In the world use such systems of heat supply long ago. Our system has advantage:
- 1) profitability, consumes the low power of energy, that is 3,5 times more, than you receives electric energy;
- 2) effective, doesn't depend on heat source, the thermal pump differs from known for the fact that, the compressor and the evaporator are combined together.

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- The solar collector - the main heat generating solar power plant knot from power, operational indicators which the corresponding parameters of a solar power plant directly depend. Therefore bulk, registered in the world the invention and patents, it is concentrated generally in the field of creation new a design and technologies for solar collectors.
- Key parameters of solar collectors (Civil Code) and consequently, and solar power plants are prime cost of the made thermal energy.
- The Civil Code can be made of expensive, but durable materials counting upon reliable work and long service life. The Civil Code can be also made of available inexpensive materials and to be cheap, but to possess a smaller resource of work.
- Both options are real and demanded by life and will be in demand if prime cost of thermal energy is lower, than at the competing installations of similar appointment.
- However in both cases the value and the price of group of companies will be defined by the new materials put in his basis, the found constructive, technological ideas and solutions.
- The greatest recognition in the world, and the greatest group among solar collectors is formed tubular also by the flat collectors (FC). From more than 6000 technical solutions patented for the last 15 years, more than a half is the share of the personal computer and more than a third on the tubular collectors (TC).

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- Main advantages of the personal computer: flat simple forms of basic elements; technological effectiveness of production that makes them available for production and production in the countries with various technological level.
- At the same time, the known personal computers have a number of essential shortcomings which consist in the following.
- Known in the PC market material-intensive, are expensive. The mass of the personal computers, most widespread in the CIS countries, makes from 30 to 40 kg/sq.m. An exception Raduga Group (Russia) the weight by which it is lowered to 22 kg/sq.m at the cost of 500 dollars/sq.m.
- The mass of the personal computer is in countries of Western Europe at the level of 25 kg/sq.m at the cost from 250 dollars/sq.m and above depending on quality.
- The inventions directed to decrease in mass-dimensional parameters, and through it and the cost of the personal computer a set. But monitoring for the last 5-7 years shows that essential results didn't manage to be achieved.

- Main objective - is development and development of release of solar power plants economic in the conditions of Kazakhstan, due to application of essentially new solar collectors.
- For achievement of a goal it is offered to realize new approach to designing of solar collectors with use of modern materials at the expense of what to achieve essential decrease (2-3 times) in solar power plant cost.
- The essence and novelty of the offered method consists that unlike the known principle of designing, the collector contains a transparent double-glazed window 2 with double glass and with the reduced pressure, and also perimetric frame 1. The bottom of a wooden frame 7 it is made of plywood 8 mm thick. and to them the heat-insulating film 5 with a foil is pasted. In a gap formed between a double-glazed window and the bottom of a frame the flexible thin-walled corrosion-proof corrugated tube of 4 □ 16 mm is laid. in the form of a coil. The ends of a tube are attached to the entrance and output sticking-out pipes 6. Other space is filled completely in with bitumen 3 with the BN-90 brand 30 mm thick. GOST-0015 of 1807-97.

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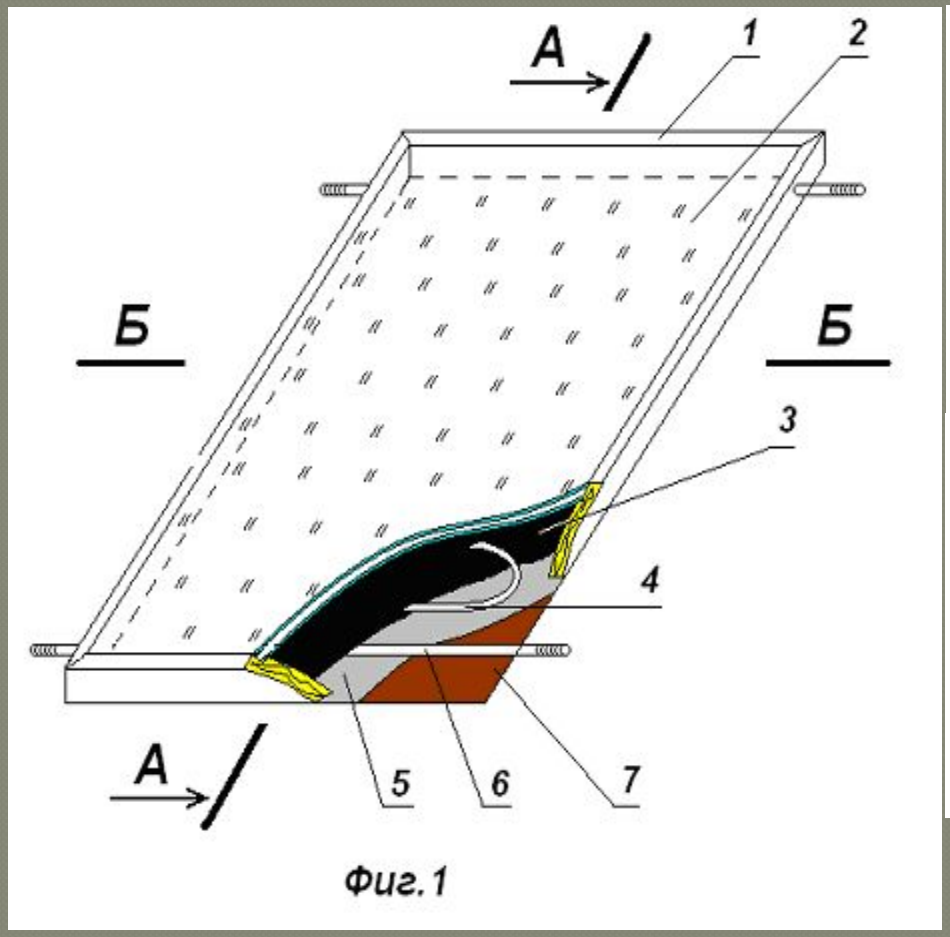
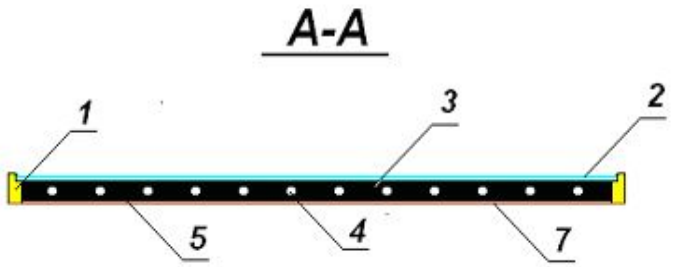
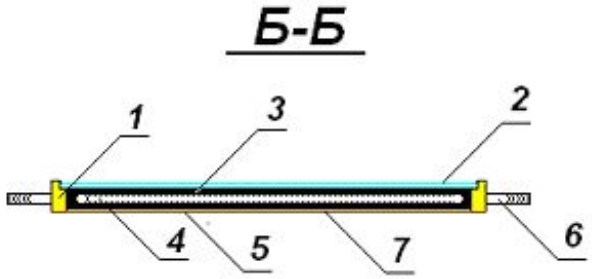
FLAT SOLAR COLLECTOR WITH THE BITUMINOUS ABSORBER WITH THERMOSIPHON CIRCULATION



Фиг. 1



Фиг. 2



Фиг. 3

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FLAT SOLAR COLLECTOR WITH THE BITUMINOUS ABSORBER

- Technical characteristic
- Number of layers transparent insulation 2
- The area of one collector, sq.m to 2
- Average temperature of heating of water, ° C 60-80
- transflective ability concerning sunlight when falling sunshine on a normal to a surface 0,89
- Specific volume for the heat carrier, l/sq.m 2,0
- The absorbing ability concerning sunlight 0,99
- Working pressure, MPa 0,7
- Overall dimensions, m 1x2
- Work of coefficient of optical efficiency and effectiveness ratio of the absorbing panel 0,8
- Work of the general coefficient of thermal losses of a collector and effectiveness ratio of the absorbing panel 0,75
- The relation of the area of the heat perceiving surface to the dimensional area 0,95
- Mass of a collector, kg 60
- Service life, about 15 years

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- Advantage of a flat collector: it is possible to develop the area of one collector to 2 sq.m, the simplified manufacturing techniques, a possibility of work under pressure.
- The collector differing in what a bituminous absorber on color is similar to an absolute black body and therefore for 0,99% absorbs solar radiation, and is covered with a transparent double-glazed window with reduced by pressure which is itself the heat-insulating material.
- And also that the bituminous weight filled between transparent a double-glazed window and the bottom of a collector is heat-retaining material, the corrosion-proof thin-walled corrugated tube gives the chance at smaller to length more than the area contact with the heat carrier.

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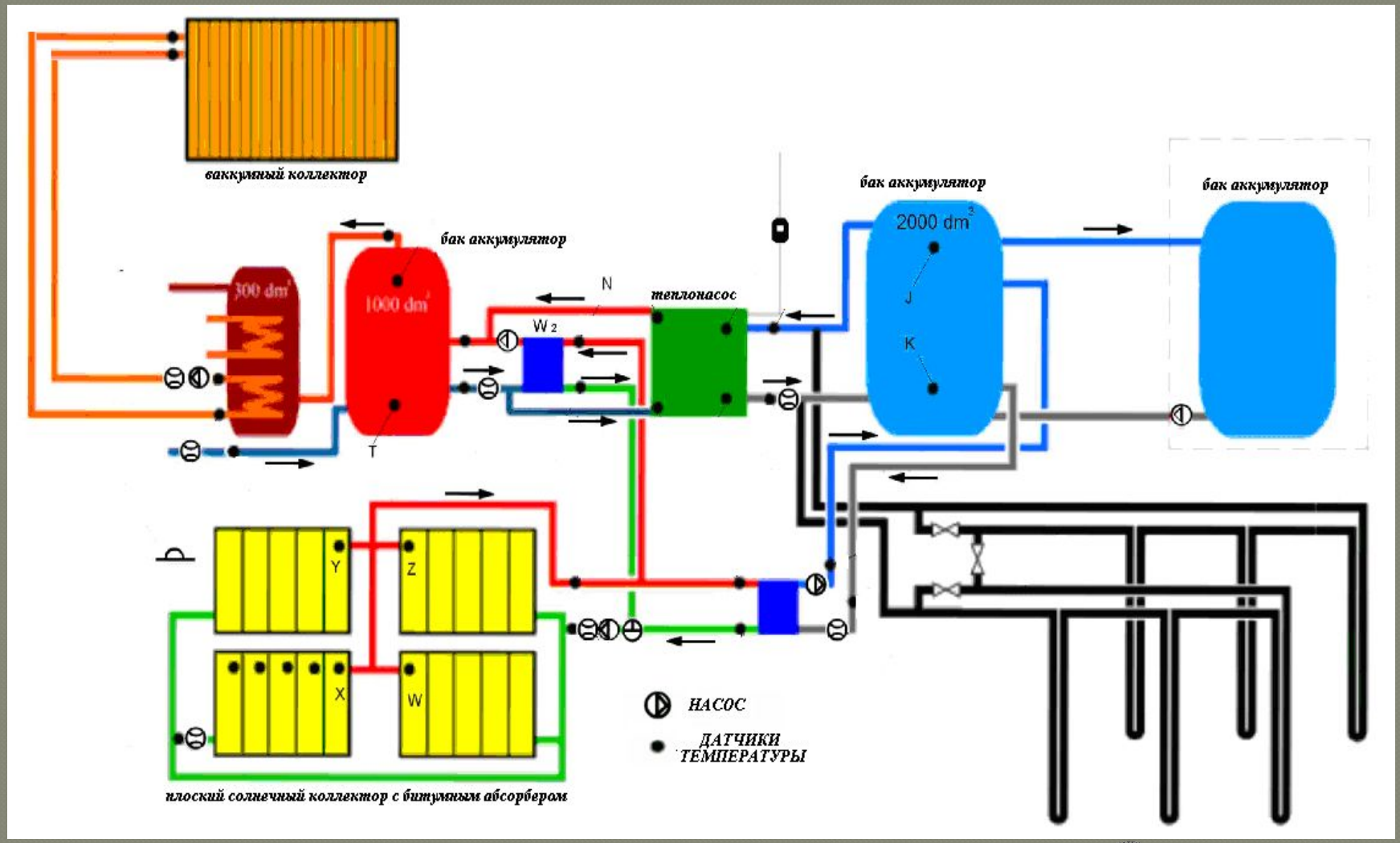
SCHEMATIC DIAGRAM OF HYBRID SYSTEM



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THERMAL PUMP
THE COMPRESSOR AND THE EVAPORATOR ARE COMBINED TOGETHER

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Key design data of heat pump

- External diameters of the evaporator and
- condenser (D2), mm … … … … … … … … … 375,0
- Internal diameter (D1), mm … … … 325 and 307
- Height heat exchange mm … … … …… …. 355 and 382
- Width mm … … … …. 20 and 30
- Volumes dm3 … … … … … 0.52 and 0,8
- Diameter of the feedwell divider, mm … … … …... 238
- Excess of height of the evaporator over
- height of the compressor, mm ……. … … … … … 80,0

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Structural and technological system

- The schematic diagram of a double-circuit solar power plant with thermal the pump where two to a planimetric solar power plant form three main knots is developed: solar collector 1, thermal pump 2, storage container (SC) 3. The solar collector consists of translucent covering 4, the absorbing panel 5, the case 6. The thermal pump – from the evaporator 7, the compressor 8, the throttle valve 9, the condenser 10. The storage container turns on the condenser 11 heat exchanger, automatically operated reserve electric heater 12, the heat exchanger of system of heating 13. Also DGU is supplied with automatically operated circulation pulsers of the first of the 14 and second contours 15.

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Planting operation

- Solar energy E, is absorbed by a solar collector, heating the heat carrier circulating through group of companies and the heat pump evaporator. The evaporator, absorbing heat of the heat carrier, lower than temperature of atmospheric air lowers his temperature, thereby promoting additional absorption of heat and from atmospheric air (Q2). On the scheme are also shown the sunlight reflected from a translucent covering (Q0) and a surface of the absorbing panel (Q1). In heat pump transmission of energy of the heat carrier (Q3), with rather low temperature, to the condenser 10 heat exchanger heat carrier with more high temperature is carried out. For implementation of such cycle the compressor 8, with the electric drive is used. Further, by means of the heat exchanger 11 heat from heat pump (Q6) is transferred in accumulator tank where water temperature is carried to the required technological level by means of a reserve source and moves to the consumer on the purpose of hot water supply and heating. In parallel with the main stream, there are heat losses – from a surface of the compressor (Q4) and a surface of the heat exchanger of the condenser (Q5)

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- The used devices: a recording potentiometer of KSP-4 for record of temperatures of heating of heat carriers and environment; pyranometer M80, with GSA galvanometer for measurement of intensity of sunlight (E); laser Center-350 thermometer.
- Research of influence of the new constructive solution of TN has been conducted on the basis of comparison with basic option in which utilization of heat of the compressor hasn't been provided. The problem was solved with use of a method of quasinatural modeling for an exception of possible external hindrances. For this purpose instead of group of companies the electro water heater with an adjustable power which carried out functions of group of companies has been established.
- Researches have been conducted at the capacities of "solar collector": 500, 1000, 1500, 2000, 3000, 4000 W. In figure 4 schedules of temperatures and heating capacity basic (without utilization of heat of the compressor) and new TN are shown at the power of "solar collector" of 1500 W. Schedules of basic option are taken from the doctoral dissertation of the research supervisor.

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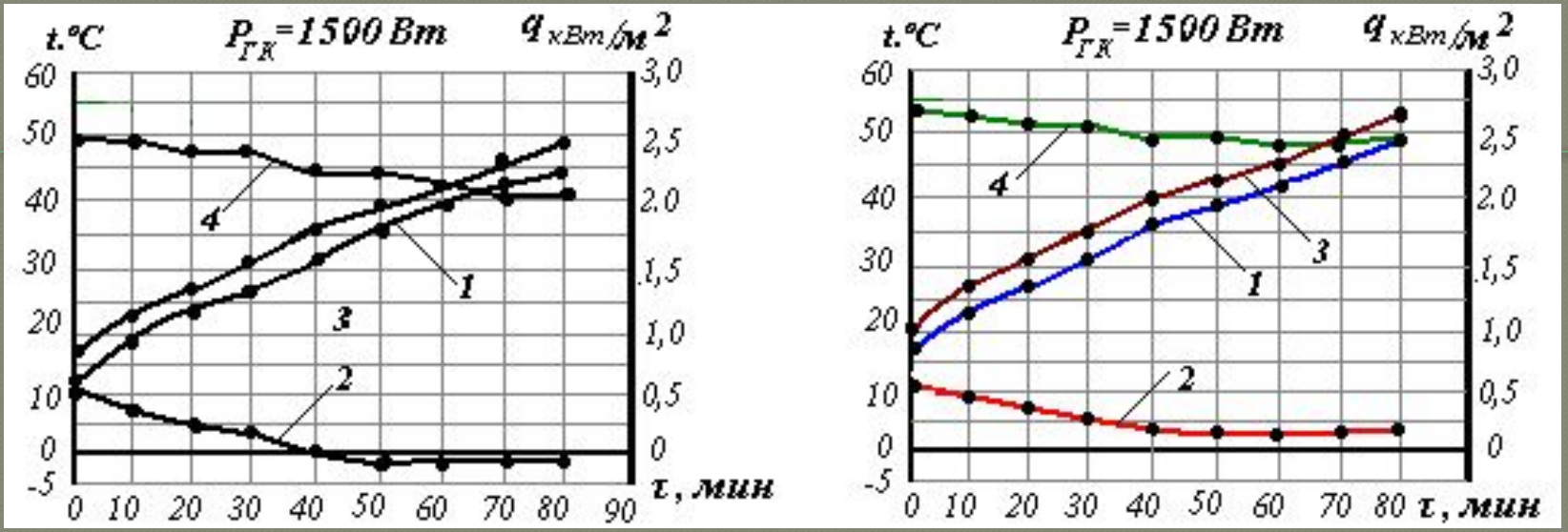

1 and 3 – heat carrier temperatures at the exit and an entrance to the heat pump condenser; 2 – heat carrier temperature in group of companies; 4 – specific heating capacity of dual solar plant

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Conclution

- From the analysis of results it is established that at all modes in new option, in comparison with basic, temperatures of heat carriers in a solar collector, on an entrance and an exit from the condenser, change towards increase. Growth of heating capacity at all modes is observed. At the power of Civil Code of 500 W heating capacity of new option is higher in comparison with basic at the beginning for 15%, for 20% at the end. At the power of Civil Code of 1500 W heating capacity of new option is, respectively, 12% higher and than 17%. At the power of Civil Code of 3000 W there is an alignment of power of "solar collector" and heating capacity of the heat pump evaporator, but heating capacity of new option in comparison with basic continues to remain higher, but at the beginning and the end it doesn't change, and make about 10%.

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- Economic and preliminary tests of an experimental sample of dual solar power plant . By results of the carried-out the specification and drawing documentation on production of an experimental sample of dual solar power plant are developed, and also his economic tests are carried out. Economic tests took place in farm "Mergenovykh" of Talgarsky district of Almaty region which have confirmed operability of dual solar power plant . Positive results of researches and tests have formed the basis for development of the specification on advanced development and carrying out preliminary tests.
- The made calculations have shown that annual economic effect of dual solar power plant depends on the area of solar collectors. When comparing with the electric boiler, dual solar power plant from group of companies of collectors of 4 sq.m on kilowatt of rated capacity of the thermal pump at which the effect makes 123,0 thousand tenges on kW of rated capacity of the thermal pump is optimum.

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Thanks for watching !

Prepared for: YOUNG INVENTORS PROJECT COMPEITIONS
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