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SOLAR COLLECTOR CONTROL SYSTEM

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Solar energy is one of the areas of alternative energy. Developments from this area are being implemented in many countries, as they are the most progressive and environmental friendly. The essence of this type of renewable energy source is that the energy of the Sun is drawn, and as a result, electricity is generated.

The advantages of solar energy are its availability, inexhaustibility, and the absence of by-products that pollute the environment. The disadvantages include low density and intermittent supply to the Earth's surface, associated with the alternation of day and night, winter and summer, and weather changes.

The most widespread application of solar energy is found in heat supply systems. They serve for hot water supply, heating and other needs, which can significantly reduce the use of traditional fuel resources.

Currently, solar energy is used on a limited scale in residential and other buildings. The most widely used solar collectors installed on the roofs provide cheap hot water for domestic needs. More than 1 million of these heating devices have been installed in Russia, Japan, Australia and other countries.

Depending on the type of collector, the process of converting solar energy into thermal energy has its own characteristics. However, in any case, solar radiation heats the coolant (water, antifreeze) flowing in the tubes. Further, the already heated coolant enters the remaining elements of the system and continues to circulate. In flat collectors, to convert solar energy into thermal energy, an absorber is used - metal plates (copper and aluminum), through which heat is transferred to the coolant. Vacuum collectors are two tubes nested into each other, the space between them is filled with vacuum, which makes it possible to reduce heat loss. Inside there is a copper tube through which the evaporating liquid moves. Heat is transferred from the walls of the tube to the copper tube by means of an aluminum shield. Then the heat from the vacuum tubes is transferred to the heat collector. Air is used as a heat carrier in air collectors, but this type is quite rare and is not used in our countries.

The advantages of the solar collector are:

Fuel economy. In summer, solar collectors are able to completely cover the building's hot water demand. In the off-season - in spring and autumn, collectors reduce the load on the gas boiler, which ultimately reduces gas consumption.

In winter, the collectors operate with very low efficiency.

Energy independence. By using a solar collector for heating, you reduce your own dependence on gas. The collector is an additional source of heat. At least in summer, you can get hot water for free without using gas. You can get the same result with heat pump heating.

Availability. No permission is required to install the solar collector. All you need is a straight-handed plumber and a competent salesperson who knows all the features and subtleties of installation.

Long service life. The service life of the collector is over 15 years. This means that you will be able to use free solar heat for a very long time.

Their main disadvantages are:

Cost. Prices for solar collectors for heating water range from 500 dollars to 1000 euros apiece. A complete ready-to-use system consisting of two collectors will cost from $ 2,500. Considerable initial investment, with a payback period of 7 to 10 years.

Impermanence. The sun cannot be turned on and off at will. Therefore, the collector cannot be considered as the only source of heat.

We need a storage tank. For the operation of solar collectors, a storage tank is required. If it is not provided in your heating system, then this will entail additional costs for the purchase of collectors. As a result, based on all the information described, one can draw a conclusion: solar energy is one of the most progressive developments in the energy sector of the future, but with all its advantages, it has a number of disadvantages that cast doubt on its use. Such disadvantages are:

- long payback of equipment;
- low efficiency when using a solar collector (panel) in a temperate climatic zone.

In order to neutralize these shortcomings, it is necessary to use control systems. The main task of any control system is to increase the productivity of the controlled device. Consequently, by increasing productivity, we reduce the payback period of equipment for a solar collector. The block diagram of the developed solar collector control system is shown in Figure 1.

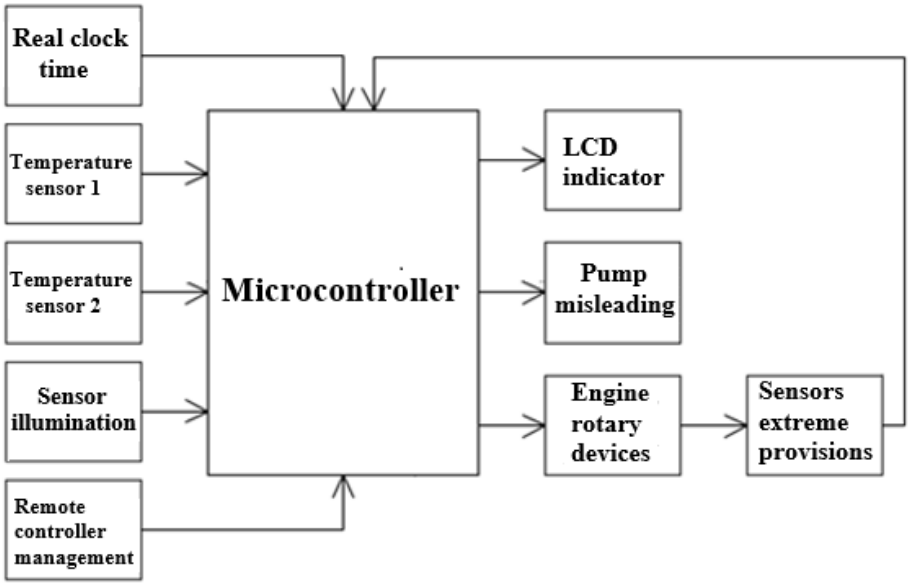

Figure 1. - Block diagram of the developed solar collector control system

Development and description of the hydraulic circuit of the device. A hydraulic diagram is a technical document containing information about the structure of a product, its constituent parts and the relationship between them in the form of conventional graphic images or symbols, the action of which is based on the use of the energy of a compressed fluid. The hydraulic diagram for connecting a solar water heater is shown in Figure 2.

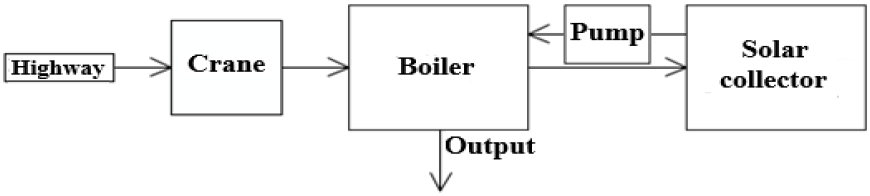

Figure 2. - Hydraulic diagram of a solar water heating installation

The solar water heating system consists of a solar collector, a boiler (water tank) and a pump. When the tap is open, water from the water main enters the boiler. Further, through the solar collector, water circulates, which is heated by the energy of the sun and is then forcibly pumped into the boiler with the help of a pump. Hot water is stored in the boiler until it is used, so it must have good thermal insulation.

REFERENCES

1. Erickson, John; «Radiolocation and the air defense problem: The design and development of Soviet Radar 1934-40», Social Studies of Science, vol. 2, pp. 241—263, 1972.
2. Ширман Я. Д., Голиков В. Н., Бусыгин И. Н., Костин Г. А. Теоретические основы радиолокации / Ширман Я. Д. — М.: Советское радио, 1970. — 559 с.
3. Бакут П. А., Большаков И. А., Герасимов Б. М., Курикша А. А., Репин В. Г., Тартаковский Г. П., Широков В. В. Вопросы статистической теории радиолокации. — М.: Советское радио, 1963. — 423 с.
4. Янушкевич В.Ф. Зондирование анизотропных сред двухчастотными и модулированными сигналами / В.Ф. Янушкевич // Полоцкого государственного университета. – Минск – 8 с. – Деп. в БелИСА 12.06.97 г. - № Д 199713 / Рефер. сб. непубликуемых работ. – 1997. – Вып. 5. – С. 11.
5. Теория электрических цепей: учеб.-метод. комплекс для студентов специальности 1-39 01 01 «Радиотехника» / С.П. Алиева. – Новополоцк: ПГУ, 2010. – 364 с.
6. Метрология и радиоизмерения: Учеб.-метод. комплекс для студ. спец. 1-39 01 01 «Радиотехника» / Сост. и общ. ред. В.Ф. Янушкевича. – Новополоцк: ПГУ, 2005. – 304 с.
7. Микроконтроллеры AVR [Электронный ресурс]. – Режим доступа: http://www.electromonter.info/handbook/13/ElectromagneticRelay.