Artificial Continuous Air Current Generation Plant


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Abstract—A plant theoretically capable of generating a 24/7 continuous induced air stream and the concept of this plant are described, as well as its operational principle and materials from which the plant will be manufactured. Arguments in favor of the relevance of this plant are adduced.

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INTRODUCTION

Today, the share of electric power produced at generating facilities operating on traditional fuels is around 60%. However, these fuels have two major disadvantages: first, their quantity is limited; second, extraction and use of hydrocarbon fuels are very harmful to the environment.

According to Federal Law 261 On Energy Conservation, Energy Efficiency Improvement, and Amendments to Particular Legislative Instruments of the Russian Federation, legal, economic, and institutional bases have been formed to encourage energy conservation and improve energy efficiency [1]. On this background, reduced fossil fuel consumption is a priority area for power and heat generation, as well as replacement of such fuels with renewable energy sources (RESs).

One of these sources is wind; its potential exceeds current power consumption levels. If we analyze the wind patterns of Russia (Fig. 1), we can conclude that wind speeds in coastal areas are higher than in Central Russian regions, which is due to almost continuous air convection in them.

The use of wind power is an especially acute issue in Central Russian regions. It is impractical and unfeasible to use windpower plants due to frequently varying air current speeds, which is one of the main problems impeding the development of wind power generation.

This problem is also important in Kemerovo oblast. The average annual speeds of most winds in the Kuzbash do not exceed 4–5 m/s [2]. This is a generalized value, because in one-third of the territory, the wind speed does not exceed 2–3 m/s, which makes it unfeasible to build conventional windpower plants. The territory of the oblast receives enough solar radiation for power generation and is therefore a potential area for adopting solar arrays. However, the development of solar power engineering is impeded by several problems, such as high prices, low efficiency, and discrepancy between power consumption and solar radiation peaks. It is therefore necessary to develop a new approach to using RESs [3].

One way to solve this problem is to use solar and wind power together. Solar power will make it possible to generate continuous artificial wind currents to ensure stable operation of windpower plants (Fig. 2).

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The parameters required for stable operation of the system and its components are as follows:

- the minimum speed of the generated air current must be 4 m/s;
- the operating temperature range must be from −40 to 40°C;
- the minimum thermal capacity of the storage unit (thermal battery) must be 3000 J/(kg °C);
- the minimum screen transparency must be 85%;
- the maximum reverse screen transparency must be 5%;
- the maximum air drag of the air-blowing system must be 0.001 N s²/m⁶;
- the minimum capacity of energy storage units installed in the windpower park must be 55% of the total park capacity.

The plant consists of the following components:

- a light-conducting thermoglass with a low heat conductivity coefficient, which allows solar beams to pass through and reach the system service zone with their complete absorption; a plate made of a heat-retaining material, e.g., TAMMI [4] (a reusable heat-
retaining compound material), the surface of which is covered with soot to increase the heat-absorbing capacity; a thermal battery of sodium potassium nitrate salts that make it possible to retain heat for up to 12 h, with thermal plates; a wind turbine; and heat-insulation material.

The operational principle of the plant is based on natural convection, i.e., generation of a constant air current. The conditions for air circulation through the plant are formed via the creation of a certain temperature difference between the plant’s operating range and the environment; thus, a constant air current is generated. Solar beams pass through the thermoglass and heat the thermal plate and the air between the glass and the plate. Some of the solar heat passes onto the heat-retaining material, which makes it possible to