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MULTIDISCIPLINARY DIGITAL TECHNOLOGIES WITH ELEMENTS OF ARTIFICIAL INTELLIGENCE. (Modern Multidisciplinary Digital Technologies with Elements of Artificial Intelligence and Artificial Neural Networks, and Aspects of Production and Marketing of Products Created Based on and in the Development of These Technologies in Their Interaction with TRIZ and ARIZ)

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Abstract

This article examines the application of modern intelligent multidisciplinary digital technologies incorporating elements of artificial intelligence and artificial neural networks in the development of innovative engineering solutions based on the principles of the Theory of Inventive Problem Solving (TRIZ) and the Algorithm of Inventive Problem Solving (ARIZ). Particular attention is devoted to the analysis of psychological barriers, established engineering stereotypes, and the technological and commercial factors influencing the transformation of inventive concepts into competitive market-oriented products. The article substantiates the necessity of integrating systematic inventive methodologies with intelligent digital technologies in response to the continuous reduction of innovation cycles, increasing complexity of engineering systems, and rising costs of prototype development and experimental validation. The proposed approach emphasizes the identification and implementation of auxiliary non-obvious innovative functions capable of enhancing the commercial value, consumer attractiveness, and technological competitiveness of new products. It is concluded that the comprehensive integration of TRIZ, ARIZ, artificial intelligence, artificial neural networks, and multidisciplinary digital technologies significantly improves the efficiency of engineering innovation, supports informed decision-making, overcomes psychological barriers, and increases the probability of successful commercialization of advanced technical solutions.

Keywords: Digital Technologies; Modern Multidisciplinary Digital Technologies with Elements of Artificial Intelligence; Inventive Idea; TRIZ ARIZ; Market Demands; Technical Stereotypes; High Level of Commercial Success; Technical Contradictions; Psychological Barriers; Base for Selective Selection; Information Technologies; Non-Obvious Technical Solutions

New Directions in Element Manufacturing Technology

In composite technical solutions, the methods and technologies for manufacturing parts and components of a product are crucial factors determining the overall feasibility of implementing that product.

For example, consider a nozzle or fuel injector for an internal combustion engine.

This is one of the most mass-produced items, with over a billion such injectors being manufactured worldwide each year.

The product's consumer value is determined by several key factors: the diameter of the outlet holes and ensuring leak-tightness at high fuel pressures (up to 2000 atmospheres).

Traditional drilling technology limits the minimum diameter of the holes. However, since high pressures require holes with diameters measured in microns, the technology for creating these holes must be, for example, laser-based.

In this case, the inventor of a new injector must consider the composite aspect of the invention's novelty, expressed in compliance with the specific requirements of laser drilling equipment.

Constantly changing conditions and consumer demands, combined with local consumption standards, and cultural and national traditions (which form the basis for local consumption standards), create informal but tacitly present conditional consumer standards.

The inventor's goal is to ensure the commercial success of their invention: a fundamental understanding of the current consumer standard criteria, and the technical, operational, and functional characteristics of the new product. This is a crucial part of their commercial strategy.

Even if technological risk is eliminated due to positive test results for the new product, the risk of commercial failure remains if the inventors and their commercialization partners have not considered or understood the essence of the consumer standard for their product.

Availability of Principally New, Non-Obvious Materials

Let's consider, for example, two new structural and technological directions: cre-

ating efficient vortex tube sources and creating composite vortex generators based on efficient aerodynamic and hydrodynamic activation mixing systems.

Both mentioned technological directions require structural materials for development, which, due to their properties, will allow obtaining parameters in each of the directions that are impossible to obtain with conventional materials.

The possibility of using new materials is not absolute, and to make it possible to use them, a primary composite and structural solution is required.

Given the rather complex structure of the double vortex generator design, it is necessary to pay attention again to the environmental aspects that take place in a technically complex innovative process.

There are known cases when, for example, an internal combustion engine with an innovative cylinder layout was invented, with an extremely efficient fuel economy system, but the concentration level of nitrogen oxides and soot in its exhaust gases exceeded the permissible level according to the future standard, which should come into force in two years.

This turned out to be enough for the newest engine to be sent for revision, during which its technical solution was changed to the level of a composite one with the inclusion of previous technical solutions.

As can be seen from the diagram, the device receives electricity from a solar mini-battery with a voltage stabilizer, connected to a battery – energy storage.

In turn, the battery – storage is connected to a planar electric generator from which electricity is supplied to all actuators and, first of all, to double vortex generators creating vortex tubes in which the process of accelerated condensation takes place.

Air compression is carried out using an innovative screw compressor.

Thus, the entire supersystem of the shoulder generator for condensing drinking water from atmospheric air is a sequential complex combining several innovative subsystems, both assembled and separately having full compliance with the criteria of non-obviousness.

Figure 1. The figure shows a schematic diagram of the device, connection, and operation of a shoulder generator for condensing drinking water from the ambient air; The designations of the constituent elements are given in the figure

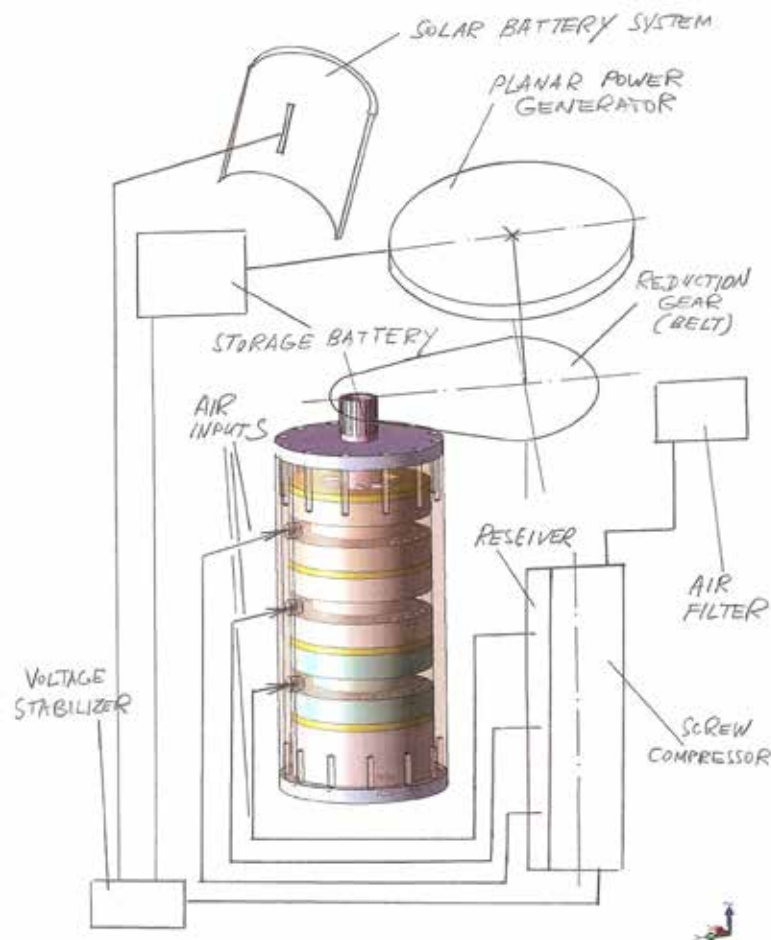


Figure 2. The figure shows a schematic diagram – a three-dimensional model of the device, connection, and operation of a shoulder generator for condensing drinking water from the ambient air; The designations of the incoming nodes and components are given in the figure

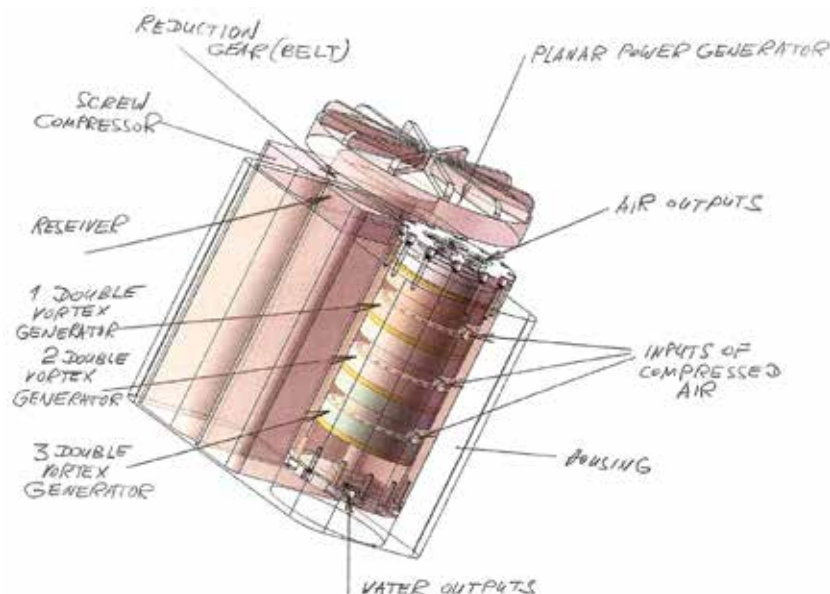
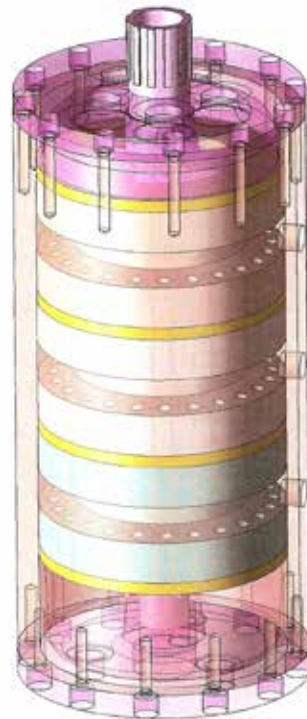
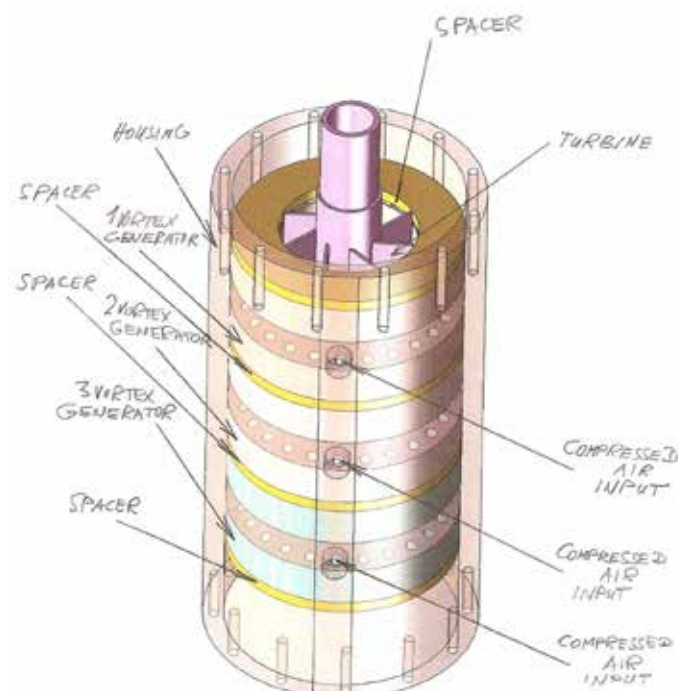


Figure 3. The figure shows a three-dimensional model of a vortex generator, which is the main actuator of a compact shoulder generator for condensing drinking water from atmospheric air



The mechanism of aerodynamic formation of accumulating local vortex tubes of the main vortex tube consists of three double local vortex generators.

Figure 4. The figure shows a three-dimensional model of an accumulating central vortex generator with the designations of the constituent components



It makes sense to link the description of the design properties and qualities of the generator with the features of the modern development of innovative developments as elements of smart technologies

Availability and Continuous Intensive Development of Software Products

The significant complication of all types of technology, and especially various electronic and microelectronic devices, has fundamentally changed the principles of their protection as objects of non-obvious, complex, multifaceted, and multifunctional intellectual property.

In addition, the recent qualification of technical solutions such as smart technologies, smart devices, and smart materials requires additional arguments for such proof.

For such objects, significant differences concerning purely design features, circuit solutions, and combinations of these solutions do not determine all aspects of the invention, since today very often all the listed features and differences can be realized in a working system or prototype only under certain conditions and manufacturing and control technology capabilities. It is manufacturing in combination with proven non-obviousness of design solutions that determines the main properties of the invention.

The development of processor control systems also determines the viability of a technical solution, which means that an algorithm or algorithms, programs, and feedback between the elements of a design or circuit become or have already confidently become an integral part of the technical solution underlying the claimed invention.

To this argument, it is necessary to add the results of a step-by-step analysis of the state of an innovative object in combination with the possibility of a non-obvious principle of using artificial intelligence and artificial neural networks.

Thus, it is necessary to combine or integrate several different technologies in one description. This combination, the identified possible channels and links of such integration, should be presented in the claims in such a way as not to allow the patent office examiner to doubt the unity of all integrated distinguishing features of the future invention and to divide it into several local technical solutions based on one technological direction.

The possibilities of integrative patenting in information technology affect a huge layer of activity in modern society.

And if quite recently it was possible to very accurately characterize or limit one or

another technological sector, then with the advent of high technologies and their offshoot, information technologies, into all spheres of human activity, such classification possibilities and protection mechanisms have significantly changed and transformed into a new system of technical solutions.

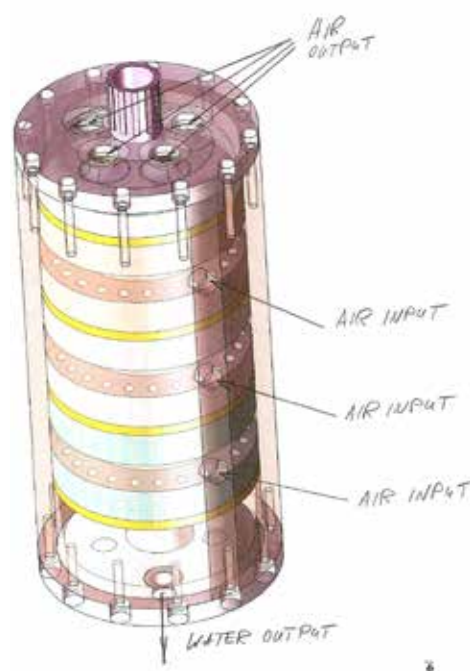
New Environmental Standards

As is known, the restrictive requirements of environmental standards are becoming increasingly stringent. When working on the invention of a new product, the use of which in any way affects the limits of permissible parameters regulated by environmental protection standards, it is necessary to ensure full compliance with the requirements and restrictions of the current standards during the operation of the new product.

As a rule, the current standards are constantly being improved, and the requirements will be systematically tightened in a planned manner in a few years.

This is especially important for various power equipment, condensation systems, and internal combustion engines.

Figure 5. The figure shows a three-dimensional model of air and water flows at the main accumulating vortex generator, which is the main actuator of a compact shoulder generator for condensing drinking water from atmospheric air



The mechanism of aerodynamic formation of accumulating local vortex tubes of the main vortex tube con-

sists of three double local vortex generators, each operating autonomously

Figure 5.1. *The figure shows a three-dimensional model of the external view of a device for condensing drinking water from atmospheric air*



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