Інформаційні технології

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MULTIDISCIPLINARY DIGITAL TECHNOLOGIES WITH ELEMENTS OF ARTIFICIAL INTELLIGENCE

Summary. *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.*

Key words: *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.*

Introduction. With the emergence of information technologies and the sharp reduction of the time cycle intended for the development and transformation of an inventive idea into an essential, market-demanded, and feasible product, the complexity of the technical and technological components of new products, causing a proportional increase in the cost of manufacturing prototypes of the invented product and their testing, force a completely new look at the possibility of creating technical solutions with auxiliary innovative functions, but non-obvious ones;

Now, if an inventor wants his innovative ideas to be used, he must be more versatile and must possess not only the technique of foresight, intuition, and to a certain extent developed imagination but also be a practically multidisciplinary specialist, at least feeling and (better if) well understanding the commercial and consumer demands of the market regardless of stereotypes and the psychological

barriers associated with them, often based on the complete obviousness of the ways of implementing synthesized ideas.

Several basic directions have a decisive impact on the fate of new ideas in today's conditions. Taking them into account can ensure a real and high level of commercial success while neglecting them will forever close the path to implementing ideas in any commercial form.

Purpose. All inventors know that sometimes technical solutions are created that, in real conditions, work, function, and solve many problems, which, even at the stage of formulation, prompted the inventor to conduct innovative analysis and initiate their focused creative activity. However, there are also contrived, obvious technical solutions that are created in isolation from reality and solve absolutely nothing, except for the realization of ambitious claims to at least some (often useless) idea in the field of engineering and technology.

Furthermore, technical solutions arising in any specific local area inevitably, directly or indirectly, affect established technical stereotypes and the psychological barriers that arise and constantly emerge based on them, hindering the overcoming of technical and technological contradictions that have arisen based on and in the development of these psychological barriers.

Twenty years ago, the necessity of inventions of the second group and the equally important necessity of considering the influence of psychological barriers were somewhat justified by their auxiliary role as a basis for the selective selection of the most effective and non-obvious technical solutions from the entire mass of initiated technical and combined creative ideas.

With the emergence of information technologies and the sharp reduction of the time cycle intended for the development and transformation of an inventive idea into an essential, market-demanded, and feasible product, the complexity of the technical and technological components of new products, causing a proportional increase in the cost of manufacturing prototypes of the invented

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The author proposes to consider some of these basic directions.

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.

New Consumer Standards

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: creating 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.

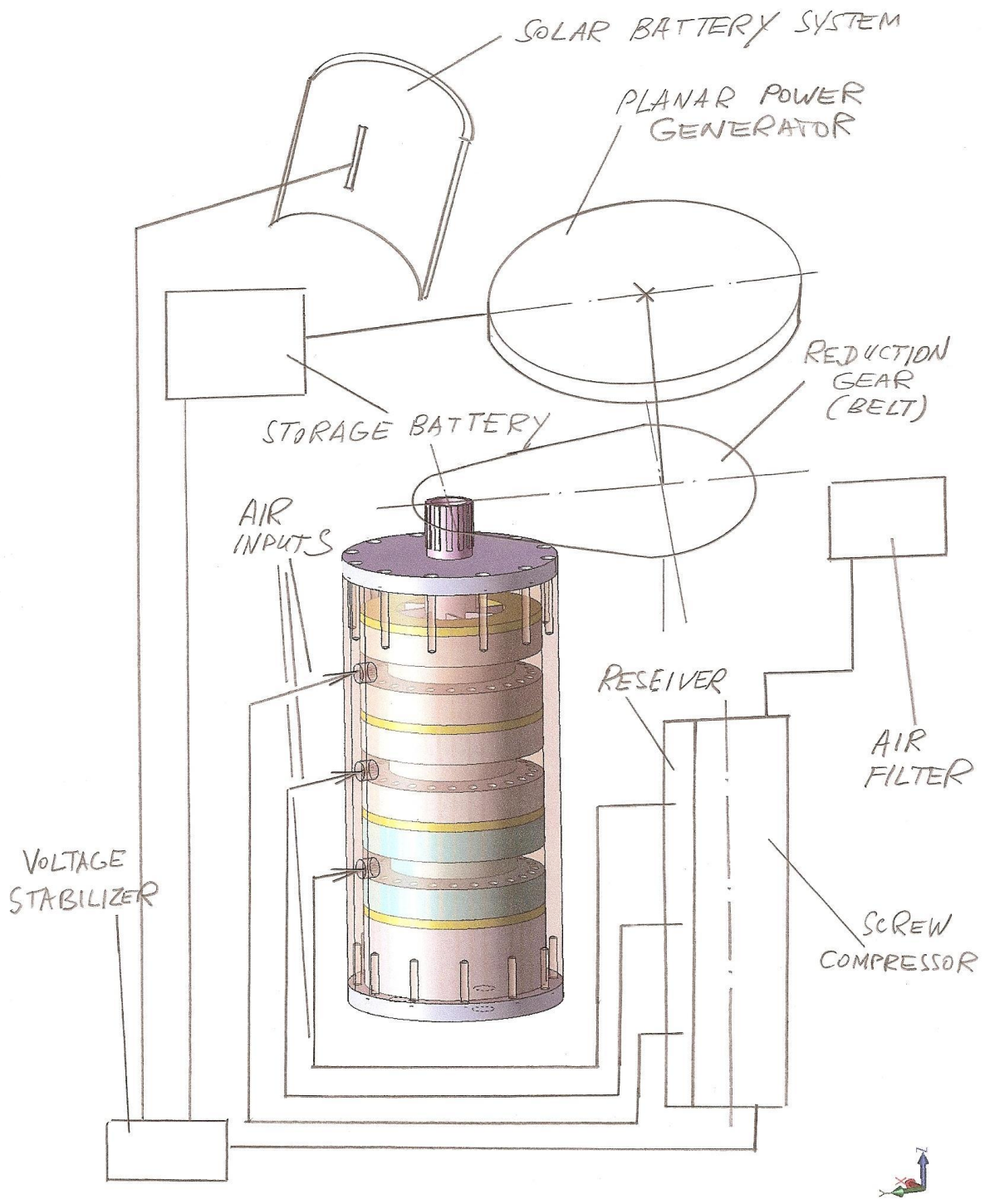

Fig. 1. The figure shows a schematic diagram of the device, connection, and operation of a shoulder generator for condensing drinking water from the ambient air; The designations of the constituent elements are given in the figure

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.

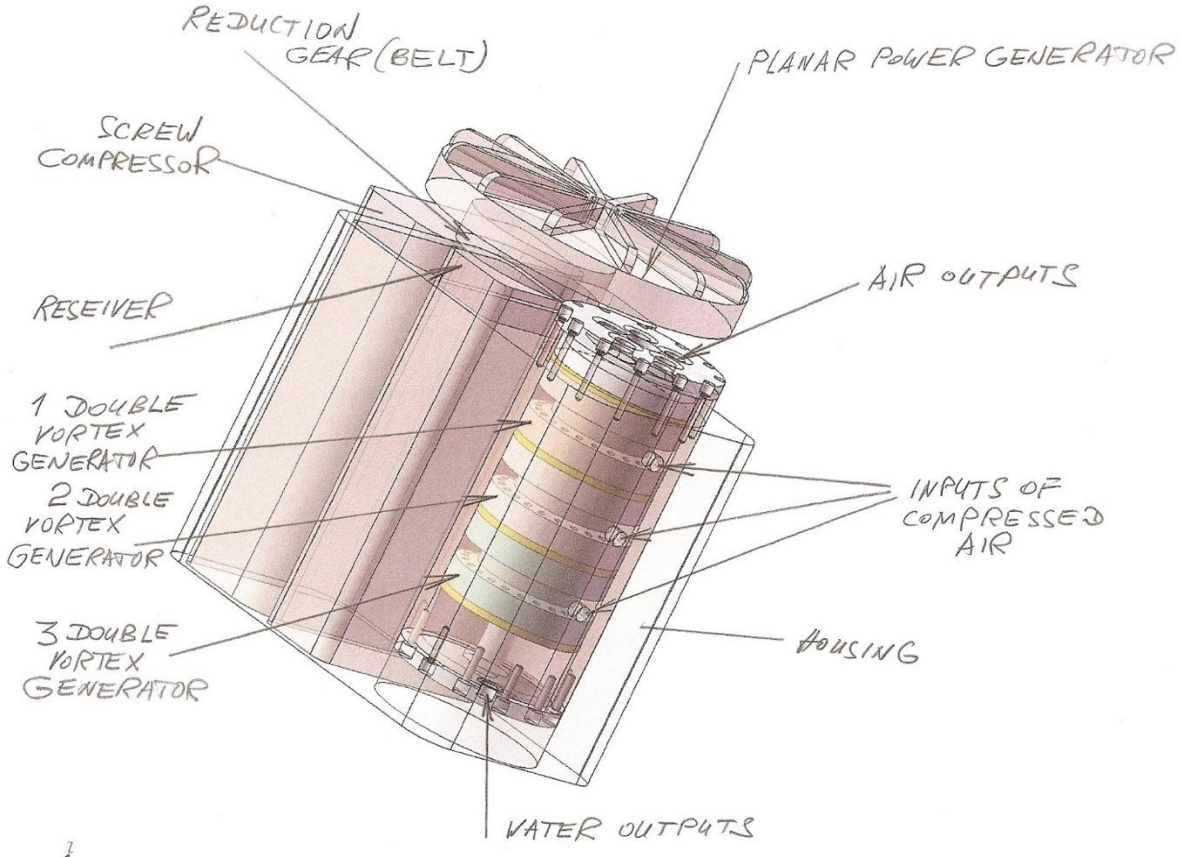

Fig. 2. the figure shows a schematic diagram - a three-dimensional model of the device, connection, and operation of a shoulder generator for condensing drinking water from the ambient air; The designations of the incoming nodes and components are given in the figure

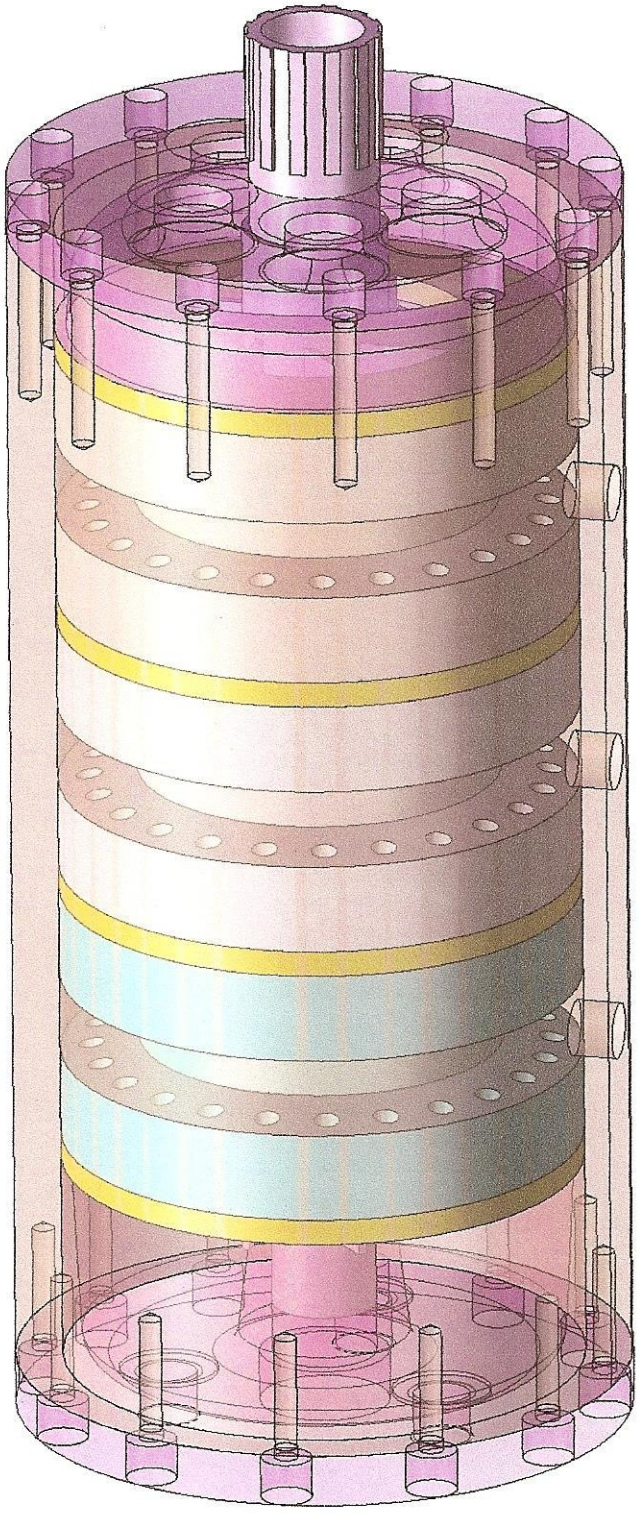

Fig. 3. The figure shows a three-dimensional model of a vortex generator, which is the main actuator of a compact shoulder generator for condensing drinking water from atmospheric air

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

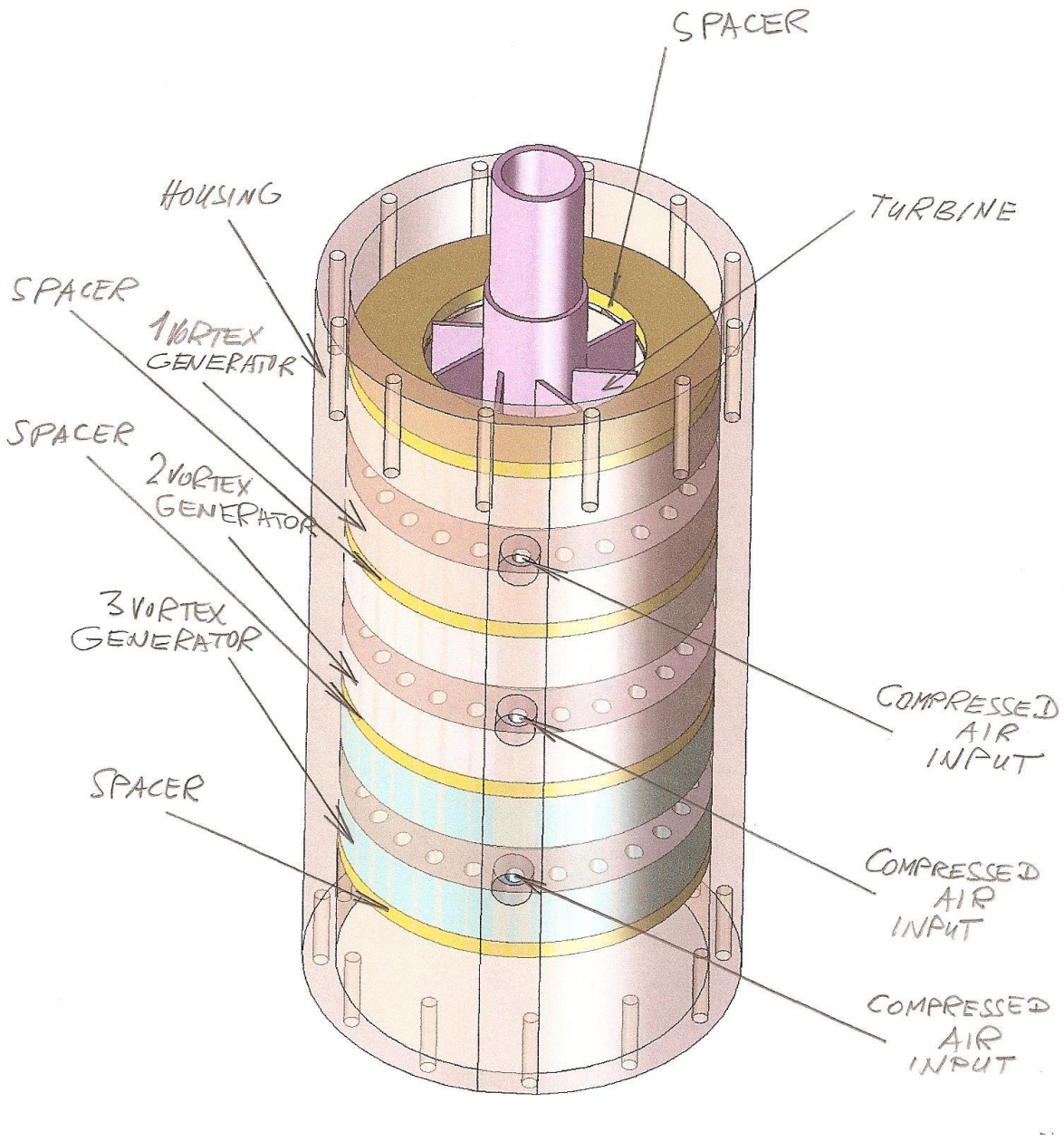

Fig. 4. The figure shows a three-dimensional model of an accumulating central vortex generator with the designations of the constituent components

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.

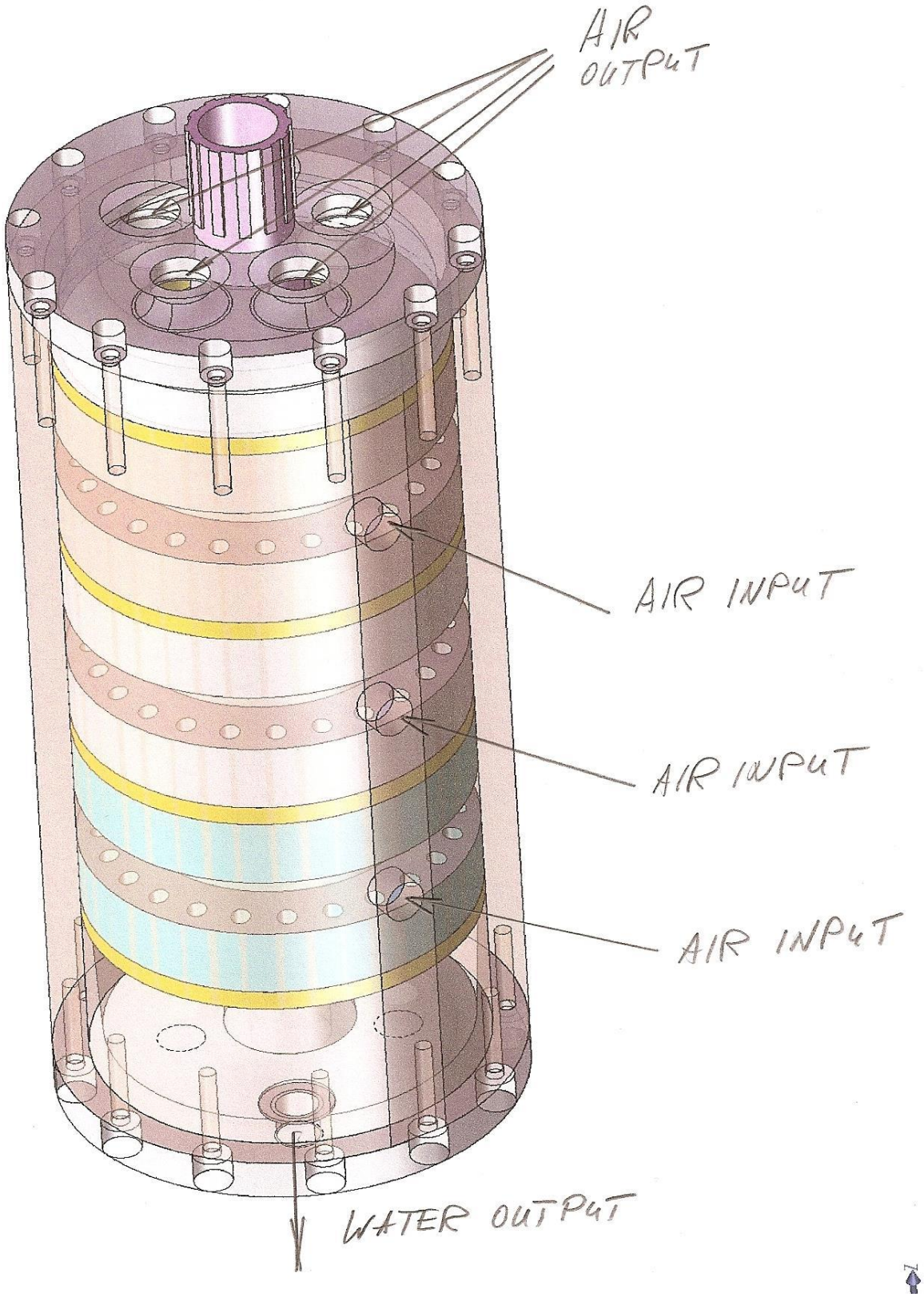

Fig. 5. the figure shows a three-dimensional model of air and water flows at the main accumulating vortex generator, which is the main actuator of a compact shoulder generator for condensing drinking water from atmospheric air

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

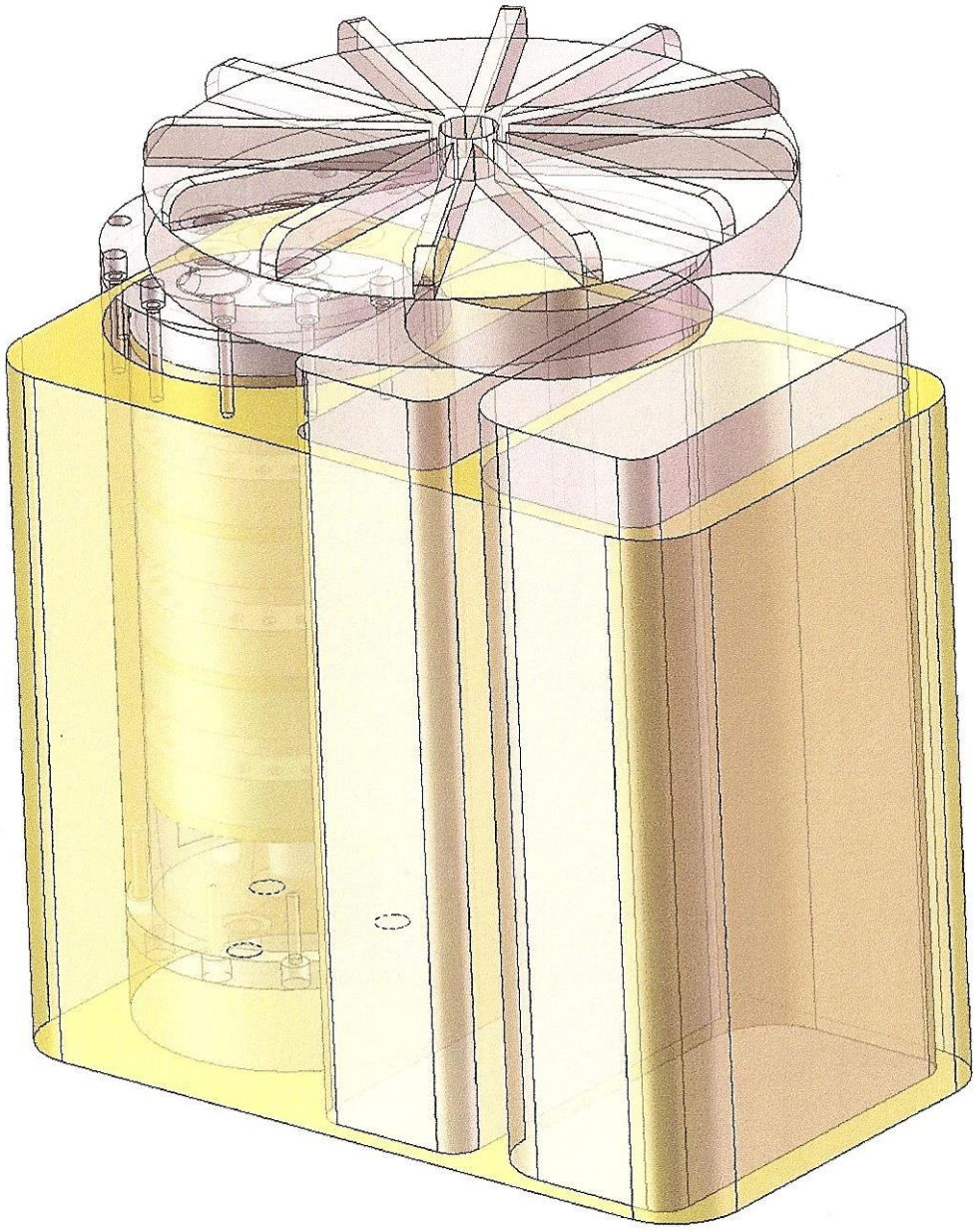

Fig. 5.1. The figure shows a three-dimensional model of the external view of a device for condensing drinking water from atmospheric air

LIST OF REFERENCES, PATENT AND LICENSING INFORMATION:

APPENDIX 1
United States Patent **10,071,918**
Ackerman **September 11, 2018**

Water harvester and purification system

Abstract

An optimized system creates potable ***water from water*** vapor in the atmosphere, or purifies salt ***water*** or contaminated ***water***. The system employs a condenser having multiple metal ***condensation*** surfaces. These ***condensation*** surfaces are cooled by coolant passing through conduits attached to the ***condensation*** surfaces. The coolant is cooled by a cooling unit. Power is supplied to the cooling unit by ***solar*** photovoltaic panels, or wind turbines, or the electric grid. The system can be ***mobile*** or fixed and can produce potable ***water*** at remote locations. The system may employ an evaporator which evaporates non-potable ***water into an air*** stream. The evaporator includes a ***solar*** or gas heater which increases the temperature of the ***air***. Metals may be extracted from the salt ***water***. If sewage is used, solid organic waste may be processed into combustible gas which is burned by an engine running a generator to power that system.

APPENDIX 2
United States Patent **4,594,082**
Catherwood, Sr. **June 10, 1986**

Dehydrating air-filtering apparatus

Abstract

A filtering apparatus for reducing problems due to ***water condensation in mobile*** or portable electronic instruments through the use of a controlled ***air*** path into an otherwise sealed enclosure. The apparatus includes a screen with a fine mesh for condensing ***water*** particles contained in the ***air*** that flows through the path with the screen positioned so that the condensed ***water*** flows out of the enclosure, and a dehydrating material located in series with the screen for absorbing additional moisture from the ***air***. The apparatus is designed to fit almost entirely within the enclosure while being readily accessible for easy replacing of the filtering components.

APPENDIX 3
nited States Patent **10,767,659**
Rolandson **September 8, 2020**

Exhaust gas recirculation compressor inlet thermal separation system

Abstract

An exhaust gas recirculation (EGR) system that utilizes an insulated separation wall that separates the hot, humid EGR gas duct from the cool, dry inlet ***air*** duct in the upstream proximity of the compressor inlet of the associated turbocharger compressor. This insulated separation wall inhibits the ***condensation of water*** droplets and the formation of ice particles near the mixing point of the EGR gases and inlet ***air*** in the upstream proximity of the compressor inlet, such that the turbocharger compressor wheel, blades, and other components are not subsequently damaged by the condensed ***water*** droplets or formed ice particles. The added insulation in this cold sink area essentially thermally isolates the hot, humid EGR gas flow from the cool, dry inlet ***air*** flow until the actual mixing point of the flows.

APPENDIX 4
United States Patent **10,759,677**
Hedlund **September 1, 2020**

Self-contained photovoltaic distillation apparatus

Abstract

The present disclosure describes an apparatus that may be used to generate desalinated ***water*** from a supply of untreated ***water*** using a photovoltaic cell. The front surface of the photovoltaic cell is partially enclosed to form an evaporation chamber. The front surface of the photovoltaic cell is exposed to sunlight or another light source. This exposure results in power generation by the photovoltaic cell and also heats the ***air*** in the evaporation chamber. Untreated ***water*** is subsequently introduced into the evaporation chamber. Upon contacting the heated ***air*** and the front surface of the photovoltaic cell, a portion of the untreated ***water*** evaporates to generate ***water*** vapor. The ***water*** vapor is then removed from the evaporation chamber and transported to a ***condensation*** chamber. The ***water*** vapor is cooled in the ***condensation*** chamber to yield desalinated ***water***.

APPENDIX 5
United States Patent **10,731,880**

Kow **August 4, 2020**

Humid air stream generator

Abstract

A humid ***air*** stream generator is disclosed. The humid ***air*** stream generator comprises a hollow cylindrical chamber (2) with a mist generator (21) placed inside at the bottom of the hollow cylindrical chamber (2) for generating a continuous stream of humid ***air,*** an inlet tubing (22) attached to the hollow cylindrical chamber (2) for feeding a stream of incoming ***air,*** an outlet tubing (8) attached to the hollow cylindrical chamber (2), a suction fan (4) placed between the outlet tubing (8) and the mist generator (21) for forming the continuous stream of humid ***air*** with the stream of incoming ***air*** into a cyclonic ***air*** flow which spiral upward towards the outlet tubing (8), so as to eliminate accumulation of ***water*** droplets or ***condensation*** at an outlet region of the hollow cylindrical chamber (2).

APPENDIX 6
United States Patent **10,583,389**
Stuckenberg **March 10, 2020**

Atmospheric water generation systems and methods

Abstract

An atmospheric ***water*** generation system comprises ***water*** vapor consolidation systems configured to increase the relative humidity of a controlled ***air*** stream prior to condensing ***water*** from the controlled ***air*** stream. The ***water*** vapor consolidation system comprises a fluid-desiccant flow system configured to decrease the temperature of the desiccant to encourage ***water*** vapor to be absorbed by the desiccant from an atmospheric ***air*** flow. The desiccant flow is then heated to encourage ***water*** vapor evaporation from the desiccant flow into a controlled ***air*** stream that circulates within the system. The humidity of the controlled ***air*** stream is thereby increased above the relative humidity of the atmospheric ***air*** to facilitate ***condensation of the water*** vapor into usable liquid ***water***.

APPENDIX 7
United States Patent **10,718,101**
Panda , et al. **July 21, 2020**

Economically viable atmospheric water generator

Abstract

A system of generating ***water from the air*** in the most energy efficient manner is provided. The ***water*** generating apparatus uses a combination of rotating pre-loader wheels of separation materials, mechanical ***condensation*** system such as Vapor Compression Cycle (VCC), filtration and mineral addition units to create an energy efficient system for generating ***water*** from ambient ***air***. An IoT ***water*** generating apparatus optimized through systems integration including smart controls and programming board for optimizing ***water*** production using weather and utility data for energy efficient ***water*** production from ambient ***air***.

APPENDIX 8
United States Patent **10,422,112**
Bravo , et al. **September 24, 2019**

Modular apparatus for water production
Abstract

A modular apparatus for ***water*** production from atmospheric ***air*** includes: a first parallelepiped module having an inlet opening, an outlet opening, a ventilator, to force an ***air*** flow to cross an internal volume of the first module, a ***condensation*** unit, located internally of the first module that intercepts the ***air*** flow, and a collecting tub for collecting the ***condensation water***; and a second parallelepiped module containing a refrigerating unit including a portion of a refrigerating circuit in which a refrigerating fluid circulates and an evaporator to cool the ***air*** flow inside the ***condensation*** unit; the first module and the second module are reciprocally fixed at a respective interconnecting face. The second module having an interconnecting face having a width equal to twice a width of an interconnecting face side of the first module.

APPENDIX 9
United States Patent **10,385,549**
Bravo , et al. **August 20, 2019**

Water production apparatus for rigorous climates

Abstract

An apparatus (10) for production of ***water*** from atmospheric ***air comprises a condensation*** unit (20) comprising: an inlet opening (21) of the moist ***air*** with a dew point of lower than 0.degree. C., an outlet opening (22) of the

dehumidified ***air,*** at least a ventilator (23) configured so as to force an ***air*** flow and enter through the inlet opening (21) and exit from the outlet opening (22), a heat exchange plate (24), interposed between the inlet opening (21) and the outlet opening (22), so as to intercept the ***air*** flow and able to be crossed by the ***air*** flow, in which a refrigerating fluid of a refrigerating unit (30) circulates at a lower temperature than a dew point temperature of the ***air*** flow and at least a heating element configured so as to heat the heat exchange plate (24) for defrosting the ice condensed thereon.

APPENDIX 10
United States Patent **9,821,263**
Hering , et al. **November 21, 2017**

Advanced laminar flow water condensation technology for ultrafine particles

Abstract

This technology relates to the enlargement by ***water condensation*** in a laminar flow of airborne particles with diameters of the order of a few nanometers to hundreds of nanometers to form droplets with diameters of the order of several micrometers. The technology presents several advanced designs, including the use of double-stage condensers. It has application to measuring the number concentration of particles suspended in ***air*** or other gas, to collecting these particles, or to focusing these particles.

APPENDIX 11
United States Patent **9,976,769**
Shinoda , et al. **May 22, 2018**

Indoor unit of air-conditioning apparatus
Abstract

An indoor unit of an ***air***-conditioning apparatus includes a body casing having an ***air*** inlet formed in an upper portion of the body casing and an ***air*** outlet formed in a lower portion of the body casing; a ventilation passage formed in the body casing; an evaporator provided to a refrigerant circuit, disposed in an inclined manner in the ventilation passage, and covering the ventilation passage such that ***air*** freely passes; a main drain pan disposed below the evaporator; and a fan disposed in the ventilation passage. The evaporator is divided into an upper heat exchanger and a lower heat exchanger. A sub-drain pan that receives dew ***condensation water*** coming out from a gap of the joint is disposed at a

downstream side in a ventilation direction of a joint between the upper heat exchanger and the lower heat exchanger.