Інформаційні технології

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MODERN DIGITAL TECHNOLOGIES IN THEIR INTERACTION WITH TRIZ

Modern Digital Technologies with Elements of Artificial Intelligence and Artificial Neural Networks in Their Interaction with TRIZ and ARIZ

Summary. *Modern intelligent multidisciplinary digital technologies, incorporating elements of artificial intelligence and artificial neural networks, generate numerous complex psychological nuances and product marketing aspects during their development, especially when interacting with TRIZ and ARIZ.*

The emergence of information technologies and the drastic reduction of the time cycle required to transform an inventive idea into a real, market-demanded, and viable product, along with the increasing complexity of the technical and technological components of new products—which proportionally raises the cost of prototype manufacturing and testing—necessitate a fundamentally new approach to creating technical solutions. These solutions may include auxiliary innovative functions, often non-obvious at first glance.

Several fundamental directions have a decisive influence on the fate of new ideas under today's conditions. Taking these into account can ensure a high level of commercial success; conversely, ignoring them may permanently close the path to commercialization of the idea in any form.

Key words: *Digital Technologies, TRIZ, ARIZ, Intelligent Multidisciplinary Digital Technologies, Product Marketing Aspects, Simulation*

of Used Structural Materials, Innovation Analysis, Paradoxes of Dynamic Fuel Component Mixing, Stereotypes and Associated Psychological Barriers.

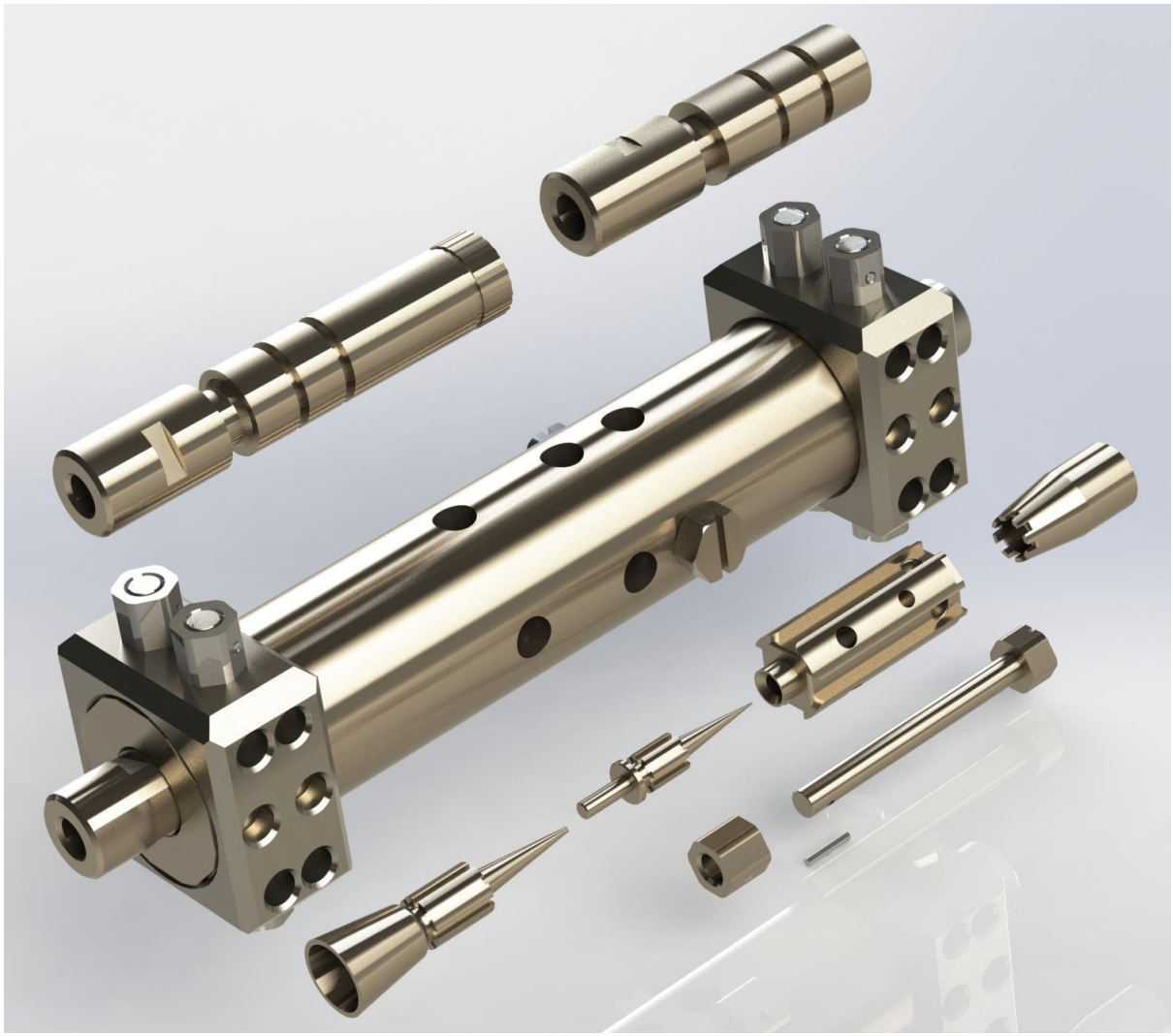

Fig. 1. An example of modern innovative design with full simulation of the used structural materials and their properties and performance characteristics, including the type of mechanical processing and finish type

All inventors know that sometimes technical solutions are created that, under real-world conditions, function effectively and solve multiple problems—problems that, even at the conceptual stage, prompted the inventor to conduct innovative analysis and triggered purposeful creative activity. At the same time, there are contrived and seemingly obvious technical solutions that are developed in isolation from reality and solve absolutely nothing, except for serving as a

means of pursuing ambitious claims to some kind of (usually useless) idea in the field of technology and engineering.

Moreover, technical solutions that arise within a specific local domain inevitably affect, either directly or indirectly, established technical stereotypes and the psychological barriers that have emerged, and continue to emerge, based on these stereotypes. These barriers often obstruct the resolution of technical and technological contradictions that evolved from these psychological foundations.

Twenty years ago, the necessity for the second group of inventions—and the equally important need to consider the influence of psychological barriers—was often justified by their auxiliary role: serving as a basis for selectively identifying the most effective and non-obvious technical solutions from the total pool of initiated technical and creatively combined ideas.

However, with the advent of information technologies and the sharp reduction in the time cycle required to transform an inventive idea into a real, market-demanded, and viable product, along with the increasing complexity of technical and technological components in new products (which proportionally raises the cost of prototype production and testing), it has become necessary to rethink the creation of technical solutions that include auxiliary innovative functions—solutions that may be completely non-obvious.

Now, if an inventor wants their innovative ideas to be adopted and implemented, they must be more versatile. They must possess not only foresight, intuition, and, to a degree, a well-developed imagination, but also be practically a multidisciplinary expert—at the very least, someone who senses (and ideally understands well) the commercial and consumer demands of the market, while disregarding stereotypes and the associated psychological barriers, which are often rooted in the perceived obviousness of how synthesized ideas should be implemented.

There are several fundamental directions that, in today's conditions, exert a decisive influence on the fate of new ideas. Taking these into account can ensure

a genuine and high level of commercial success. Neglecting them, on the other hand, may permanently block any possibility of the idea being realized in any commercial form.

The author proposes to examine some of these fundamental directions (naturally, within the scope of this article, only in a brief, thesis-based form):

For modern technological innovations—many of which are developed through active and intensive brainstorming involving a fairly large team or group of specialists, each to some degree invested in achieving an effective result (which can, in principle, be considered equivalent to the Ideal Final Result)—there are real organizational problems in the innovation process. These problems arise from objective factors, one of which is the presence of psychological, technological, and structural stereotypes, as well as the apparent obviousness of newly formed ideas and concepts.

These emerging and continuously appearing "obvious" technical, compositional, and technological solutions are often evaluated through the lens of historical experience—derived from the application of development laws and the design of industrial technologies, machines, and mechanisms that originated at least as far back as the previous century, during a time when none of the modern materials, components, and parts—especially in combination with modern industrial electronics and laser technologies—were known or used.

In addition, the integration of artificial intelligence and artificial neural network elements into the infrastructure of new technical systems significantly complicates the processes of designing and shaping the technical and technological characteristics of innovative products.

This situation is further complicated by the fact that, as noted in the first part of this publication, the recognition of a technical solution as an invention is based, in the U.S. and in most other countries, on different criteria: four in the U.S., and three in most other countries.

The fourth criterion used in the U.S. is precisely the subjective factor in evaluating a technical solution. It is this factor that initiates the gradual development and entrenchment of a psychological stereotype based on the categorization of new technical solutions as either "obvious" or "non-obvious."

The presence of such a clearly expressed subjective element introduces into the evaluation process a comparison between the proposed technical solution and well-known structural or technological elements, or combinations thereof, drawn from existing prior developments.

However, the familiarity of a particular solution and the nuances of its implementation cannot serve as objective evaluation criteria, since the determination of a solution's obviousness or non-obviousness fundamentally depends on the knowledge level and professional competence of the experts involved.

In modern designs and technological solutions, novelty is no longer a reflection of a single technical discipline, but rather the result of a combination of integrated disciplines, including electronics, microelectronics, advanced materials science, fiber optics, and laser technology. This necessitates an evaluation of obviousness or non-obviousness from multiple perspectives—an assessment that can only be adequately performed by narrow-domain experts working in collaboration with specialists in complex systems integration.

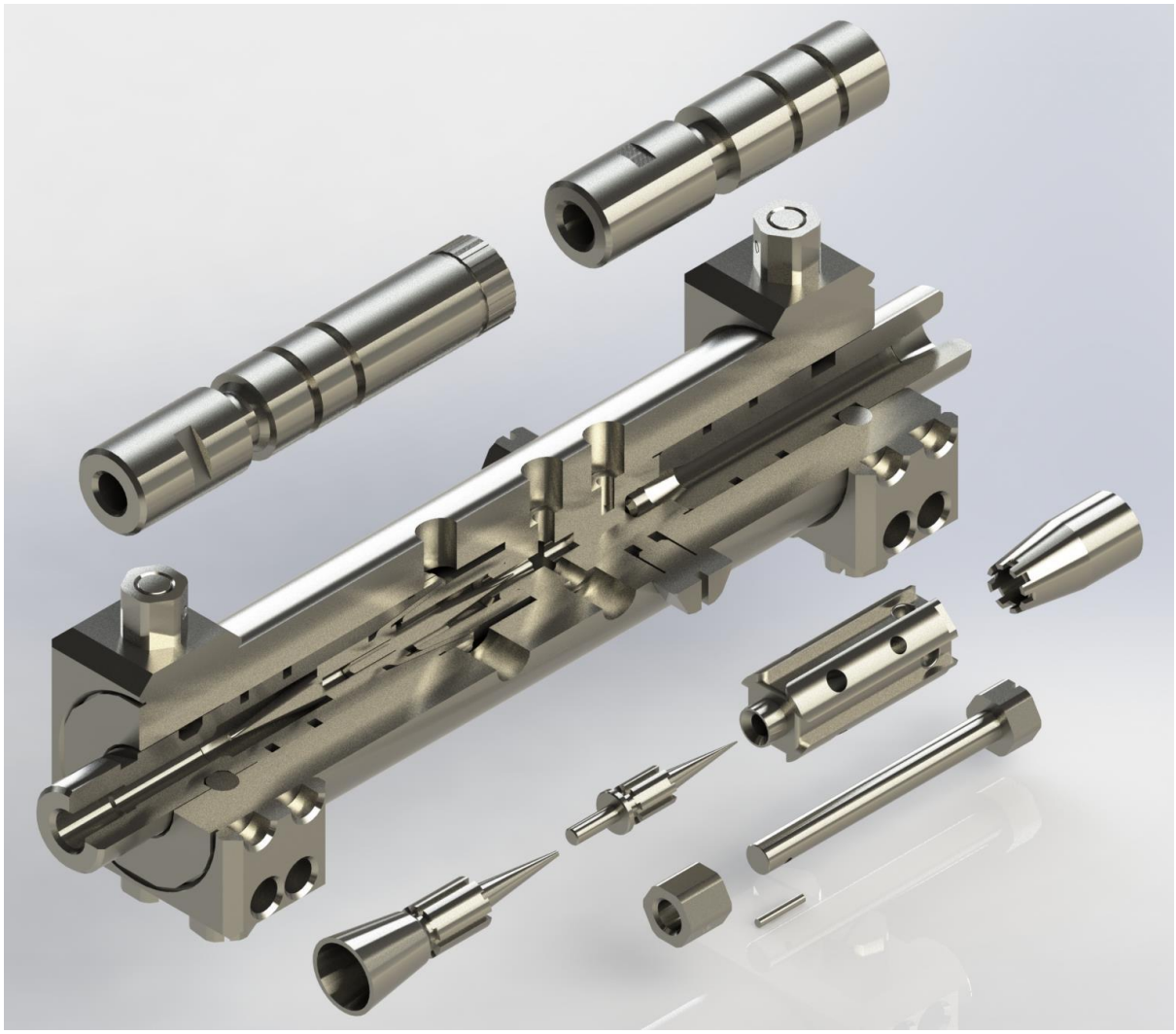

Fig. 2. An example of modern innovative design utilizing sectional views, along with a technical and innovative analysis of the level and credibility of the qualification of non-obviousness for all components of the device, as well as the same level of non-obviousness in the functional characteristics of assembly associations and the resulting commercial advantages of these characteristics

Over time, each technical discipline develops a set of typical solutions that gradually become entrenched as stereotypes, familiar to nearly all practicing professionals in the field.

Such stereotypes become embedded in everyday practice, and any changes in design or technology tend to encounter certain barriers, which, over time, evolve into well-formed technogenic psychological barriers.

In this context, effective participation in the synthesis of innovative ideas—especially through brainstorming—and the refinement of those ideas and their innovative combinations toward the boundary of the Ideal Final Result may encounter, and often do encounter, stereotypical psychological barriers. Even when part of a group generates technically viable proposals that are non-obvious to the average specialist in that specific field, such ideas are unlikely to be immediately and unequivocally accepted. They are often rejected, particularly at the early stages of development.

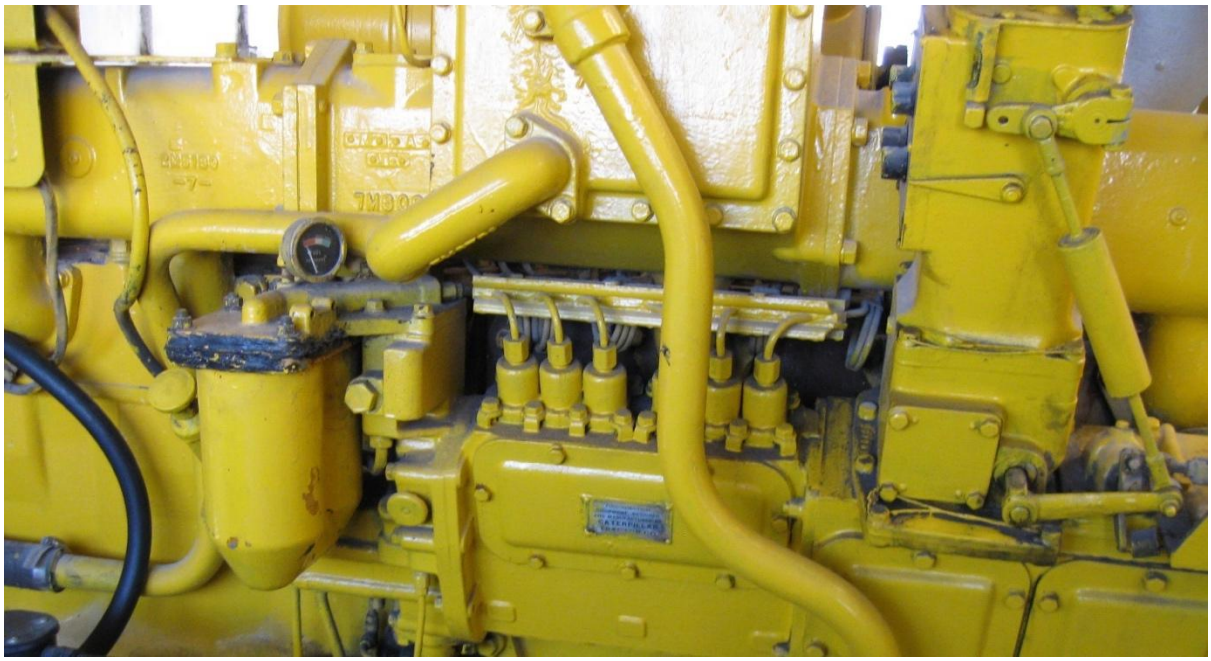

Fig. 3.The Fig. shows a view of a diesel generator being modernized by integrating a device into its fuel system for mixing and homogenizing the fuel mixture—diesel fuel with methanol

The process of developing a project for integrating a device for dynamic fuel component mixing into the fuel supply systems of thermal equipment (including boilers of all types).

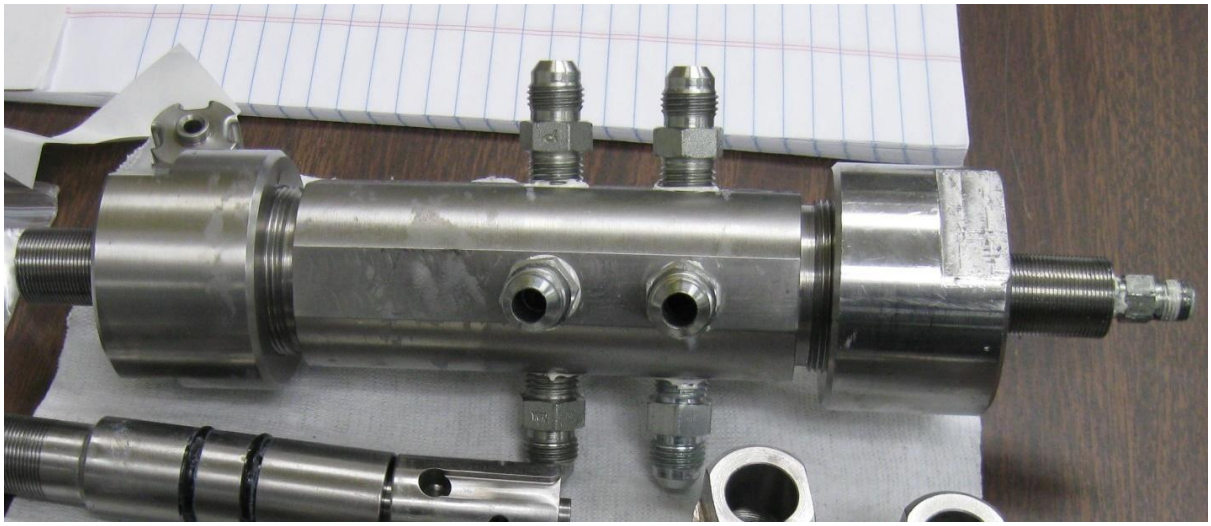

Fig. 4. The Fig. shows a device for online mixing and homogenizing fuel mixtures before injection into the combustion chamber of a thermodynamic system

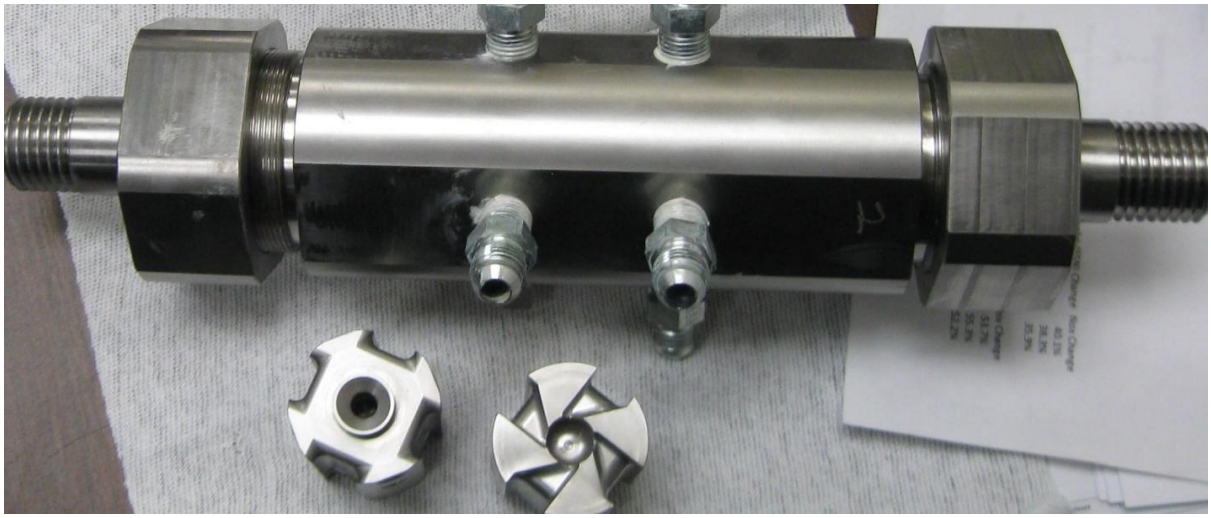

Fig. 5. The Fig. also shows a device for online mixing and homogenizing fuel mixtures before injection into the combustion chamber of a thermodynamic system, including internal components

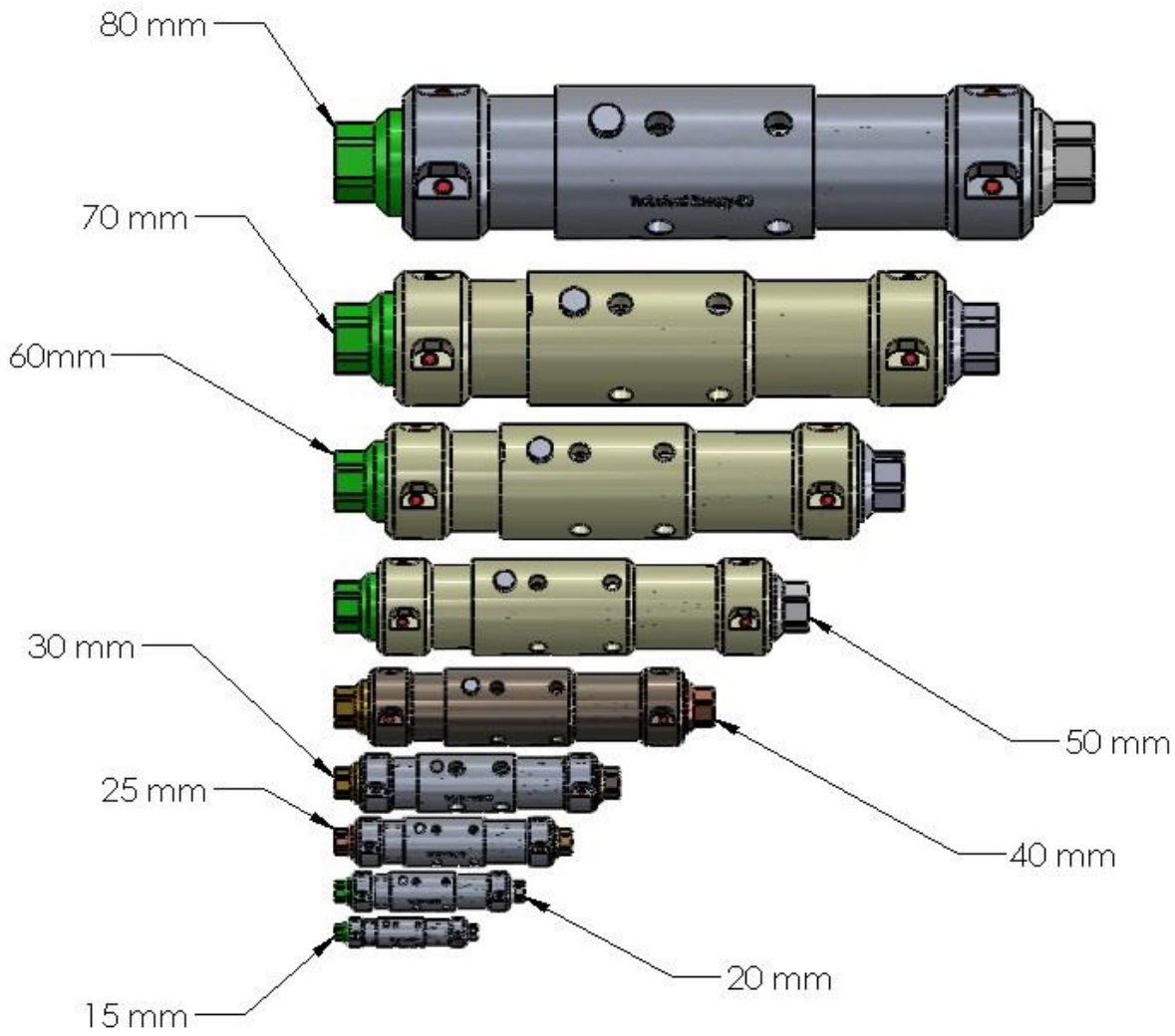

Fig. 5-1. The Fig. shows a range of sizes for devices used for online mixing and homogenizing fuel mixtures before injection into the combustion chamber of a thermodynamic system

All 9 sizes of devices for online mixing and homogenizing fuel mixtures before injection into the combustion chamber of a thermodynamic system have an equivalent internal structure and a uniform design of internal components.

Fig. 6. The Fig. shows devices for monitoring the parameters of the obtained fuel mixture

For boilers, the device must include a nozzle to ensure a higher level of adaptation to the fuel supply systems for the combustion chamber or burner. The development of the nozzle is one of the components of the project.

At the same time, the device itself can be presented as a standalone product or a compact burner.

This applies equally to boilers that use diesel fuel and to those that use natural gas as fuel.

All variants and working versions of the device and the technology for its application can be developed simultaneously and in parallel.

For devices designed for dynamic mixing of fuel components, where liquid fuel plays a dominant role, there are several paradoxes inherent in all such applications.

The first paradox is characterized by the fact that in the pipeline, with the same cross-section, the same initial pressure, and the same initial flow rate of the incompressible liquid component, a ring-shaped vacuum zone is formed without any additional energy consumption.

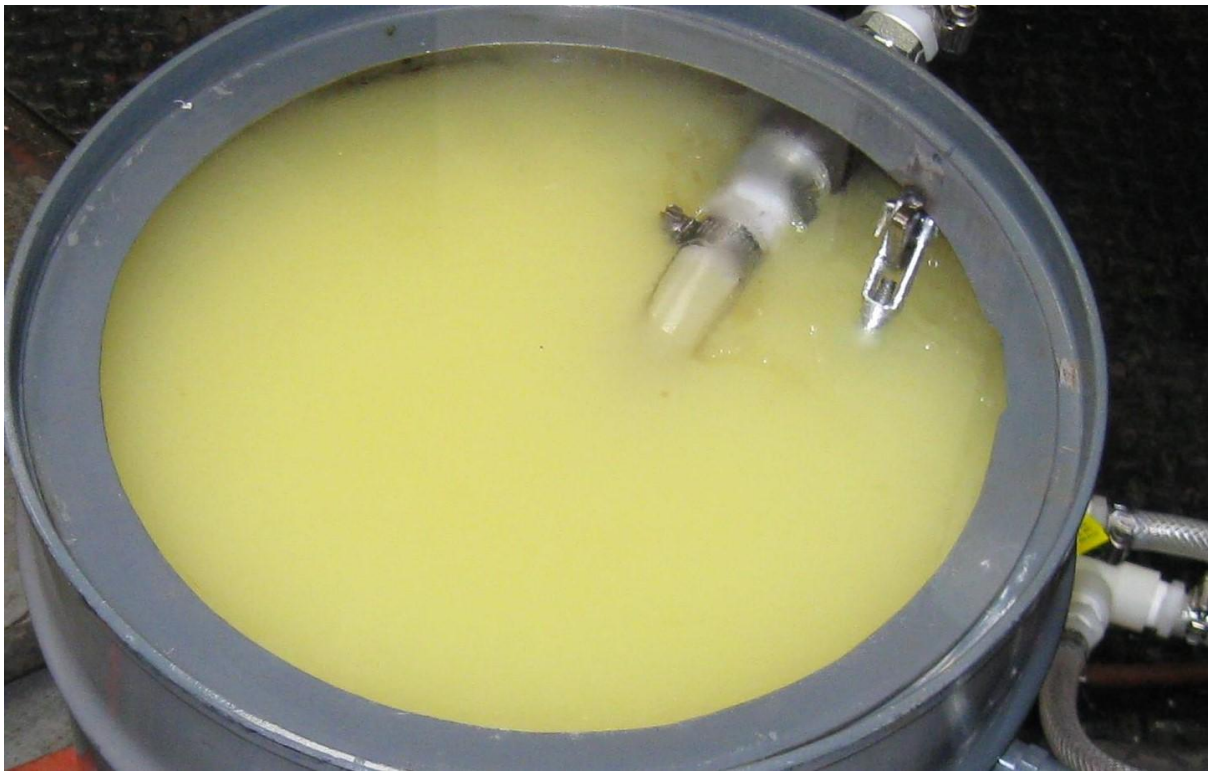

Fig. 7. The Fig. shows the appearance of the fuel mixture after structure restoration.

Fig. 7-1. The Fig. shows the internal structure of the device

Fig. 8. The Fig. shows the appearance of the fuel mixture before structure restoration

This zone represents a kind of boundary between the incompressible liquid and the compressible mixture of this liquid with gas, in this case, air.

Fig. 9. The Fig. shows systems using artificial intelligence and artificial neural networks applied during the qualification testing of the technology and device

The second paradox is that within the same pipeline, the liquid entering the pipeline changes its physical properties from an incompressible working fluid to a compressible working fluid.

The third paradox is that at the point of change in the physical properties of the flow, the flows of the liquid and gaseous components are coaxial, with the liquid component flow enveloping the gaseous component flow.

Fig. 10. The Fig. also shows systems using artificial intelligence and artificial neural networks applied during the qualification testing of the technology and device

The directions of flow at the indicated point coincide.

The fourth paradox is that in the zone, which represents the boundary between the incompressible part of the flow and the compressible part, there is a deep vacuum or rarefaction. This occurs under conditions where two coaxial flows each create a ring-shaped rarefaction zone: one created by the incompressible liquid flow, and the other created by the compressible air flow.

Both of these zones are coaxial to each other, and the thickness of the flow in them does not exceed 100 micrometers for the liquid and 25 micrometers for the gas.

The linear velocity in each of the flows in the rarefaction zone exceeds 100 meters per second, with no additional energy sources being used in the process.

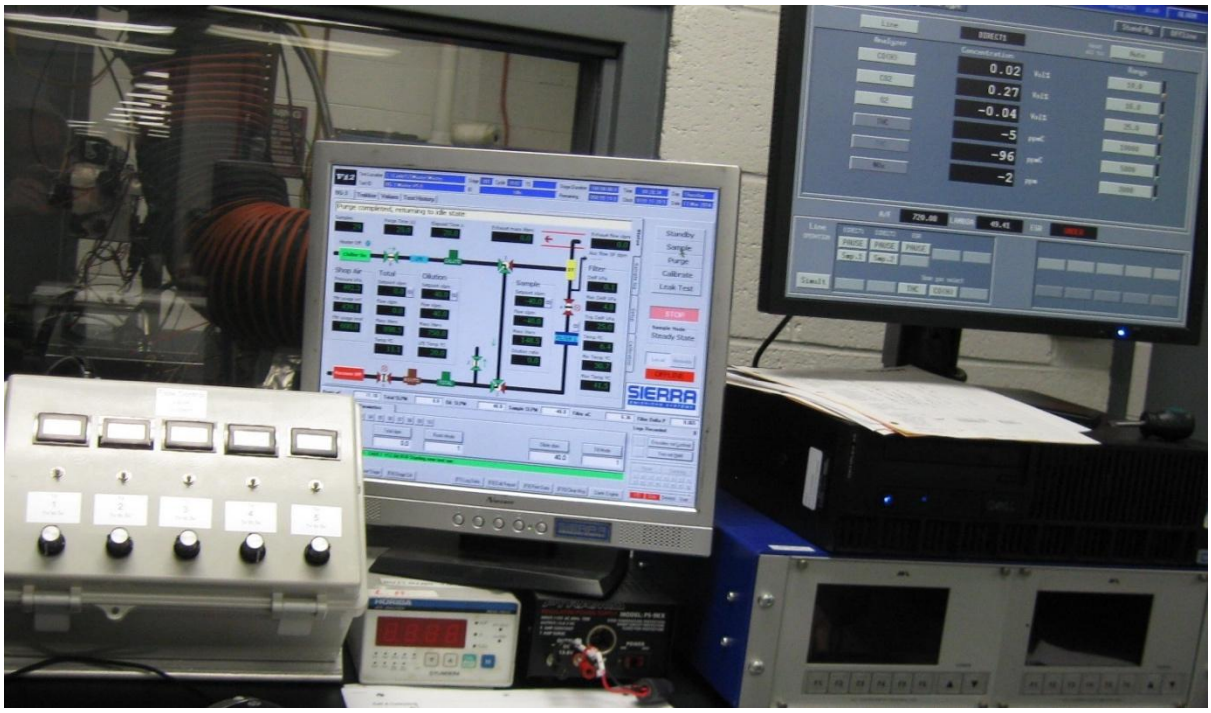

Fig. 11. The Fig. also shows fragments of the system using artificial intelligence and artificial neural networks applied during the qualification testing of the technology and device

The fifth paradox is that the flow of the mixture accumulates the kinetic energy of the flows of all components, and the kinetic energy of the mixture exiting the device exceeds the kinetic energy of the liquid component entering the device.

The sixth paradox is that under conditions of deep rarefaction and high linear velocity of the flows, in the boundary zone separating the incompressible liquid and the compressible mixture, numerous capsules of composite fuel are formed. More than 27 million spherical capsules, each with a diameter not exceeding 50 micrometers, are present per liter of mixture or fuel composite.

In these capsules, the core is a compressible element—air—and the shell is an incompressible element—liquid or a homogeneous mixture of liquids.

The seventh paradox is that when necessary, a liquid additional component of the fuel composite, such as water, can be drawn into the boundary zone between the compressible and incompressible parts of the flow.

At the same time, no additional energy is required to draw water into the liquid fuel component flow and mix it; only the energy of the liquid fuel component flow is needed.

References, Patent, and License 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
United 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.

Appendix 12
United States Patent **10,161,114**
Vaughen **December 25, 2018**

Fresh water generation system using coastal atmosphere and ocean water

Abstract

This invention is designed to create potentially unlimited commercial fresh ***water*** at a significantly reduced cost in relation to existing fresh ***water*** creation systems such as sea ***water*** desalination. This invention pumps coastal atmospheric ***air*** through sealed pipes to ocean ***water*** depths (ideally) of approximately 100-305 meters, or (ideally) into the local ocean's thermocline layer. Fresh ***water condensation*** occurs inside the sealed ***air*** pipes as cold ocean ***water*** chills the outside of the pipes. ***Condensation*** fresh ***water*** flows via gravity to the low point in the sealed ***air*** pipes where a powered fresh ***water*** pump is located. This powered fresh ***water*** pump then pumps the accumulated ***condensation water*** to the ocean surface and then on to shore as usable fresh ***water***. The pumped-in ***air,*** now dehumidified, is piped to the surface and returned to the atmosphere.

Appendix 13
United States Patent **10,337,175**
Chen **July 2, 2019**

Water generation system for deserts

Abstract

A ***water*** generation system for deserts is provided as a ***water*** generation system designed for desert climate areas and constructed in a surface pavement and generally includes a sand layer, which includes a ***water*** tank embedded therein and is covered with a moisture locking cloth on which a grading layer is laid.

A ***water*** resisting cloth is arranged in the grading layer.
Hollow ***water*** penetration tubes are arranged above the grading layer and have bottoms extending through the ***water*** resisting cloth and inserted into the grading layer with pouring and grouting of grout cement thereon to form a ***water*** pervious layer. As such, rainwater can be quickly conducted into the sand layer for storage for subsequent uses and ***air*** can be conducted into the grading layer to subject to ***condensation*** for forming condensed ***water*** on an undersurface of the ***water*** resisting cloth to achieve a purpose of automatic ***water*** generation.

Appendix 14
United States Patent **9,758,948**
Heller **September 12, 2017**

Humidity collector apparatus
Abstract

A device that collects ***water*** vapor, from the ambient ***air,*** through ***condensation*** or deposition, on the surface of its unique heat exchangers, which are embodied with opposing intertwined and alternating refrigeration circuits. In a dual refrigeration circuit/dual heat exchanger configuration, one refrigeration circuit is responsible for freezing heat exchanger A and heating heat exchanger B while the other refrigeration circuit is responsible for heating heat exchanger A and freezing heat exchanger B. The alternating refrigeration circuits work together to intermittently freeze then thaw each heat exchanger. The ***water*** run-off from the thawing process is then collected for use. The condenser tubes of one refrigeration circuit are positioned proximate to the evaporator tubes of the second refrigeration circuit to facilitate the exchange of heat. The system may further comprise heat exchanger fins in contact with the tubes. Multiple pairs of heat exchangers may be utilized.

Appendix 15
United States Patent **9,216,379**
Elliott **December 22, 2015**

Method and apparatus for drying compressed air

Abstract

This invention relates to a method and apparatus to remove unwanted ***water*** moisture from industrial, commercial and home shop compressed ***air*** systems. The invention removes ***water*** through the process of thermal ***condensation***. The reduced temperatures are generated by utilizing the

Joule-Thompson effect through the manipulation of the pressure or pressures generated by the attached ***air*** compressor

Appendix 16
United States Patent **8,967,096**
Mayr , et al. **March 3, 2015**

Condensation device
Abstract

A ***condensation*** device for an engine having a ***water***-containing lubricant. The ***condensation*** device includes a first fluid line configured to permit a flow of vaporized ***water*** to be discharged from the engine under its natural convection, a pressure-compensation device configured to permit a flow of ***air*** out of the ***condensation*** device; and a second fluid line configured to permit condensate from the flow of vaporized ***water*** in the first fluid line to flow to the engine.

Appendix 17
United States Patent **8,685,144**
Claridge , et al. **April 1, 2014**

System and method for efficient air dehumidification and liquid recovery

Abstract

The present invention relates to systems and methods for dehumidifying ***air*** by establishing a humidity gradient across a ***water*** selective permeable membrane in a dehumidification unit. ***Water*** vapor from relatively humid atmospheric ***air*** entering the dehumidification unit is extracted by the dehumidification unit without substantial ***condensation*** into a low pressure ***water*** vapor chamber operating at a partial pressure of ***water*** vapor lower than the partial pressure of ***water*** vapor in the relatively humid atmospheric ***air***. For example, ***water*** vapor is extracted through a ***water*** permeable membrane of the dehumidification unit into the low pressure ***water*** vapor chamber. As such, the ***air*** exiting the dehumidification unit is less humid than the ***air*** entering the dehumidification unit. The low pressure ***water*** vapor extracted from the ***air*** is subsequently condensed and removed from the system at ambient conditions.