ALGORITHMIC COMPONENT IN COMPLEX INNOVATIVE PROJECTS AS AN EXAMPLE OF ANALYSIS OF TECHNOLOGIES DEVELOPMENT FOR THE MODIFICATION OF FUEL MIXTURES

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The qualification of the technical level of the project, as an example, the assessment and qualification of a complex project, is a device (Fig. 1) for dynamic mixing of heterogeneous components of fuel mixtures and their subsequent activation has a very characteristic algorithmic component

Figure 1. Device and its component parts

As of today, the project is at the stage of readiness corresponding to the production and completion of the first stage of production tests of an industrial sample of a product, the device for dynamic mixing of heterogeneous components of fuel mixtures and their subsequent activation

There is one feature that needs to be analyzed to ensure the required level of online interaction between all components and components of the system.

To enable participation in processes and technologies with active monitoring of the qualitative aspects of processes and materials, as well as with sufficiently high-speed automatic control and management systems, especially high-speed electronic boards are necessary along with devices for dynamic on-line mixing and homogenization of process liquids in real-time modem, whose speed is comparable to the speed of modern computer motherboards [1]

For systems which are monitored and controlled as part of a standard aerial survey process, speed requirements are even more stringent.

The number of such electronic boards in the first place should include the so-called PCB - boards obtained by the technology of size selective etching of the metal [2]

The main difference of such boards is that the steel tape of special steel containing aluminum - 38CrAlMoA is used as the base carrier in such boards.

The thickness of such a tape is only 50 microns, which makes it possible, compared to a conventional carrier made from getinax or textolite, to sharply reduce the distance between the structures on both sides of the board.

It makes sense to consider this specific technology, since there are significant differences compared to conventional printed circuit boards in the process of manufacturing of such board.

Consider the technological transitions for the manufacture of such boards, taking into account all the features and specific differences.

For the manufacture of such boards it is necessary to perform the following operations:

- preparation of the surface of the steel tape (roll) (instead of the steel, metal can be indicated, if the metal tape provides the properties and condition of the tape made of steel 38CrAlMoA); When preparing the surface, of course, one should apply mainly reagent-free technologies and disinfection with the help of water with corrected values of acidity and alkalinity.-

- application of photoresist, the production seriality plays a role here, depending on the seriality, a method of applying photoresist can be chosen and there are several fairly well-developed, one-type application methods that also differ depending on the type of photoresist and other local conditions

- photoresist development - there is experience in using serial conveyor lines of photoresist development with full recirculation of technological solutions and with full regeneration of all consumables, water and chemical reagents

- high-speed jet electrochemical coating of nickel (2-3 microns thick); This type of electrochemical coatings is the object of a separate invention and it is only being developed in technological processes of electronics and microelectronics; The main characteristic features of this invention are: anodes rotating in the plane of a parallel metallized surface and containing soluble elements inside the working volume, in front of the injection plate; extremely small distance between the anode plane and the cathode (metallized surface); electrolyte injection through the injection board of the anode module is perpendicular to the metallized surface (cathode); in this configuration, the metallization rate is 10 times higher than conventional metallization.

- high-speed jet electrochemical coating of copper (25-35 microns thick);

This type of coating is similar to nickel and has the same distinguishing features, but is fundamentally new and requires further clarification.

It can be said that this type of coverage and its consistent technological redistribution is to some extent a phenomenon and since this technological phenomenon is the main basic difference and forms a package of significant advantages of the method, the author considers it necessary to give some explanation to this phenomenon.

To qualify all the distinguishing features of this process, the following definition is given:

So it offers a comprehensive technical solution, which is a combination of technological transitions and operations, materials and tools, such as:

- High-speed jet electrochemical coating is a galvanic process that is carried out directly in the area where the metallization layer is applied in certain and specific conditions with the following distinctive features and technological characteristics First of all, it is necessary to clearly define the nature of the electrolyte flow formed;

- Initially, it was determined that the metallization process is conducted in a selectively oriented electrolyte flow, in which the electrolyte is directed and injected onto the surface to be metallized, while the electrolyte consumption is strictly controlled in order to eliminate the negative edge effect on the cathode of the coated surface;

- Initially, it was determined that the metallization process is carried out in a directional electrolyte flow, while the direction of the electrolyte jets is defined as perpendicular to the surface being metallized;

- Initially, it was determined that the metallization process is carried out with a constant, recirculating electrolyte;

In which (recycling system) include:

1) electrolyte tank with certain parameters of the electrolyte content mode, such as:

- specific values of nickel and copper concentration, ensuring maximum efficiency and optimum density of the deposited layer, in the absence of the edge effect and with the same thickness of the deposited layer throughout the PCB topology;

- specific electrolyte temperature values

- specific values of acidity or alkalinity of the electrolyte

- specific values of electrolyte density

- specific values of conductance (conductivity) of the electrolyte

(It should be especially noted that, due to the advantages of the technology, there is no need to use organic brightener additives, which significantly simplifies the electrolyte recycling processes)

2) filter pump

3) an anode for inkjet metallization, which has components soluble in this type of electrolyte and components insoluble in this type of electrolyte; due to the fact that an insoluble element enters the interelectrode space, and a soluble element is installed in the internal cavity of the rotating anode, it becomes possible to reduce the concentration of metals in the electrolyte, which actually simplifies the recycling process:

- the successive anode system includes, installed successively in the direction of the electrolyte, soluble elements, the dissolution of which restores the required level of metal concentration in the electrolyte and insoluble elements separating the metallization zone from the metal dissolution zone in the electrolyte
- there is a certain amount of special technical conditions and dependencies, and it should be noted that:

the insoluble component is made of a composite, carbon-graphite, conductive fabric with several working layers, pressed or combined, the insoluble component must be with a sufficiently defined geometric shape and must be located parallel to the metallized surface and last along the electrolyte and first before the surface to be coated (cathode) [4]

Both components of the anode system, both soluble and insoluble, must be connected to a positive electrical potential and must have selectively adjustable hydrodynamic permeability for the electrolyte

In the anode there is a system of uniform distribution of electrolyte along the plane of the soluble component, which is automatically repeated on the insoluble component and, consequently, on the metallized surface — cathode.

In general, the process includes the following technological operations:

- photoresist removal

- pickling iron from one side to half the thickness of steel tape

- removal of etching products from the surface by aerodynamic and behind this hydrodynamic effects using foam generators (separate independent invention)

- pressure testing flowable polymer composition in this order:

    - monomer pouring
    - subsequent polymerization
    - thermal stabilization

- iron pickling from the second side (with the same differences)

- pressure testing from the second side (with the same differences)

- applying a tread on electrically conductive structures

- vacuum coating of all heat-conducting structures - a layered system of semiconductor nanostructured polycrystalline diamond films

Due to the fact that, principle defines the parameters and technical and technological conditions for printed circuit boards of process control systems for optimizing fuel mixtures are defined at the level of requirements and conditions of compliance with the possibility of conducting remote online monitoring and monitoring in real time, including in parallel with aerial photography, consider the state of the further stages and stages:

The test results are satisfactory and fully consistent with the calculated

The following project stages have been completed and completed:

- The formulation and description of the proposal - a technical proposal

- Development of preliminary baseline product specifications.

- Development of product technical requirements.
- Development of a technical project and materials for filing applications for inventions on which the product is based and the technology implemented with it.
- Development of the working draft and the whole set of technical, design and technological documentation for the manufacture of a prototype from aluminum.
- Prototype manufactoring from aluminum and its testing
- Development of the working draft and the whole set of technical, design and technological documentation for the prototype manufacturing of a sample of an industrial level product from structural and composite materials used on products of similar purpose.
- Development of programs for the manufacture of parts of the device - a prototype of a sample of a product on equipment with digital program control.
- Sample prototype manufacturing on industrial product level
- Development of a program and testing methodology for a prototype product sample
- Preliminary tests of the prototype of the product sample (the test results fully comply with the technical requirements for the product and technology)
- Development of the program and methods of sample prototype production tests of a product partially integrated into serial thermal process equipment
- Tests of the product sample prototype (the test results fully comply with the technical requirements for the product and technology)

Preparation of a full technical report on the test results, consisting of:

- Report on the comparative tests of the product prototype sample when mixing and activating light diesel fuel with air at a nozzle with low resistance
- Report on comparative tests of the product prototype sample when mixing and activating light diesel fuel with air in a nozzle with increased resistance

- Report on comparative tests of product prototype sample when mixing and activating light diesel fuel with water (15% water to 85% diesel fuel) and air with an injector with increased resistance

- Report on comparative tests of the product prototype sample when mixing and activating light diesel fuel with water (30% water to 70% diesel fuel) and air with an injector with increased resistance

- Preparation of the second stage of the formation of materials for applications for inventions created in the framework of the project

- Preparation of the analysis of the results of manufacture and testing of the product prototype sample

- Preparing a forecast for the further development of the developed technology and its application areas

- Strategy and algorithm for the formation of basic subjects of intellectual property in projects to create efficient thermodynamic technologies

The sequence of algorithmic stages.

Based on the prevailing circumstances and the general state of the new technological direction, the creation of efficient thermodynamic technologies to optimize all types of fuel mixtures, mainly for use in industrial and individual power engineering, it seems appropriate to apply the following sequential action scheme to form the basic subjects of intellectual property in the above technological areas :

- initial patent protective documents to be drawn up in the form of an application for issuance of a provisional US patent or a Russian patent for a utility model; all materials for the relevant application must be prepared in accordance with the requirements for the design of patent applications accepted in the United States for the utility patent application;

- in case an application was submitted for a utility model, same day, same materials must be filed in the United States as a provisional patent application;
- in case of if within 11 months, the application material did not require changes, then this application is submitted as a USA utility patent application and does not require any additional costs;
- at the same time, if within 11 months, it became necessary to make changes to the application materials, the adjustment is made in provisional patent application and this corrected application must be apply like PCT application
- thereafter, the application period for additional inventions in the form of CIP comes and this process can be effective for both the utility patent application and the PCT

Such strategy allows to minimize the costs of performing the work and at the same time maximally protects the technical solution that underlies the invention.

The algorithm of integration of local technical solutions, each of which has a level of invention in a combined integrative technical solution with a complex effect.

Structural analysis of the group of technical solutions underlying the design of the device for dynamic mixing and activation of the components of fuel mixtures consisting of the main liquid component, additional liquid components and the activating gaseous component, showed that this integrated technical solution contains following local technical solutions in a constructive version presented in qualification tests:

- the system of the method and device to increase the level of turbulence in the fluid flow, with the geometric structural transformation of the cross section of the flow and increase its linear velocity;
- method and device for the formation of an annular zone of reduced pressure in the hydraulic pipeline;
- method of mixing in the flow of two liquids, at least one of which is of organic origin;

- the method of summing the kinetic energy of the flows of liquid and gaseous working environment during their dynamic mixing in a tightly closed volume;
- the system of the method and device for increasing the level of turbulence in the flow of gaseous working agent, with the geometric structural transformation of the cross-section of the flow and increase its linear velocity;
- method and device for forming an annular zone of reduced pressure in a pneumatic pipeline;
- method and device to convert directional fluid flow into directional aerosol flow;
- device for separating the flow of liquid and gas before mixing and combining them after mixing;
- device for separating the flow of liquid and gas before mixing and combining them after mixing into a vortex flow;
- method and device to form a double zone of reduced pressure in a hydraulic pipeline, when it is connected to a pneumatic pipeline;
- method and device to connect hydraulic and pneumatic flows during their dynamic mixing
- method and device for changing the direction of flow of the working agent in the pipeline;

All of the above solutions allow us to form together a number of common technological solutions, which are part of the integrated integral solutions in this technology and its application options.

These solutions include:

A method and device for pre-mixing the components of a liquid fuel in a fuel pipeline.

Algorithm and logistics of the project development for the integration of the device for the dynamic mixing of fuel components in the fuel supply systems of thermal equipment including boilers of all kinds

Applied to boilers, the device must have a nozzle for a higher level of adaptation with the systems of fuel supply to the combustion chamber or burner

Nozzle development is one of the components of the project.

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

This applies equally to boilers using diesel as fuel, as well as boilers using natural gas as fuel [5]

All working versions of the device and technologies of its application can be developed at the same time, in parallel

There are a number of paradoxes that are inherent in all applications for devices intended for dynamic mixing of fuel components in which liquid fuel dominates.

The first paradox is characterized by the fact that in the pipeline with the same cross section, with the same initial pressure, with the same initial consumption of the liquid non-compressible component, an annular vacuum zone is formed, without additional energy consumption

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

The second paradox is that within the same pipeline, the fluid entering the pipeline changes its physical properties from non-compressible working agent to compressible working agent

The third paradox is that at the point of change the flow of its physical properties, the flows of the liquid and gaseous components are coaxial and the flow of the liquid component covers the flow of the gaseous component

The fourth paradox - there is a deep rarefaction or vacuum in the zone which is the boundary between the non-compressible part of the flow and the compressible part of the flow, under conditions where two coaxial flows create each annular rarefaction zone, of which one zone

is created not compressible. fluid flow, and the second annular rarefaction zone is created by 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 a liquid, and 25 micrometers for gas

The linear speed in each of the flows in the vacuum zone exceeds 100 meters per second, despite the fact that no additional energy sources are used.

The fifth paradox is the mixture flow accumulates in itself the kinetic energy of the flows of all components and the kinetic energy of the mixture leaving the device exceeds the kinetic energy of the liquid component of the mixture entering the device

The sixth paradox is under conditions of deep dilution and high linear flow rate in the boundary zone separating the non-compressible fluid and compressible mixture, a lot of composite fuel capsules are formed, more than 27 million spherical capsules with a diameter of no more than 50 micrometers per one liter of mixture or fuel composite

The seventh paradox is a liquid additional component of the fuel composite, for example water, can be drawn into the boundary zone between compressible and non-compressible parts of the stream; [6]

At the same time for drawing water into the stream of liquid fuel component and for mixing with it no additional energy is required, except the stream energy of liquid fuel component

The application of dynamic mixing technology of the fuel mixture components in the vehicles engines corresponds to the original algorithmic model

The technology of pre-mixing and activating the fuel mixtures components includes two main basic options;

The first option is to pre-mix gasoline or diesel fuel with the amount of air that is necessary for optimal combustion conditions.

After mixing, the mixture should be injected into the engine cylinders at the most optimal time in order to exclude losses of engine power, which is spent on overcoming the dead points of the engine motion conversion mechanism

Over 62% of the fuel is consumed as minimum and 70% as maximum currently

The first version of fuel system modernization of internal combustion engine allows to spend at least 55% less fuel than at current production engines for obtaining the equivalent engine torque.

Considering the distance that vehicle can travel using the pre-dynamic mixing technology the engine should spend 1 gallon of fuel for at least 40 miles away, unlike the engine that consumes 1 gallon of fuel for 20 miles today when using the technology of preliminary dynamic mixing of fuel components.

Tests of preliminary dynamic mixing technology in boilers using diesel fuel have shown high efficiency in reducing the concentration of toxic substances in exhaust gases [7]

The reduction should be more than 40% in relation to the concentration obtained on conventional engines

To test the effectiveness of the proposed technology, it is necessary to equip the internal combustion engine with a device for pre-mixing the components of the fuel mixture, which must be designed and manufactured to meet the conditions of a particular engine (Fig. 2)

Figure 2. Product size range - devices for online optimization of fuel mixes

The size of the device must be equivalent to the rate of fuel consumption for engine operation under normal conditions.

It is necessary to develop and manufacture nozzles to connect the device which should take into account the features of the engine and the capabilities of the device for preliminary dynamic mixing of fuel components.

Test requires a compressor that is able to provide the required amount of air at the required pressure and all the necessary instruments for measuring the flow rate and pressure on all 4 lines of the compressed air supply to the device, which must also be designed and manufactured

Piping should be conducted from the device to each of the engine cylinders which should contain pressure and flow measurement instruments as well as safety valves; this system must be designed and manufactured

An electronic system of injection sequence in each of the cylinders should be designed and manufactured which will allow to conduct injection and ignition at the moment when the engine motion conversion mechanism is not in one of the dead points; algorithm and necessary software must be developed for this system.

The fuel system of the engine must be refined, manufactured and installed in order to be able to control the flow and pressure of the fuel in front of the device for preliminary dynamic mixing of the fuel components and a fuel pump with adjustable pressure and flow and the necessary regulating equipment must be installed

Control parameters

The following basic parameters should be monitored during test:

- torque
- engine running time at a certain torque
- fuel consumption for the control time of the engine at a certain torque
- concentration of toxic substances in exhaust gases (as required by environmental standards)
- auxiliary control parameters do not matter when comparing the test results of the device mounted on the engine and the engine in the usual configuration

The second variant differs from the first one in that water is added to the mixture in the proportion of 15% of water to 85% of organic fuel.

In this embodiment, fuel economy is increased by 15% and the mileage per 1 gallon increases to 46 miles.

Test preparation should additionally include the design and manufacture of a water supply system, which should include components for cleaning, storing, entering water into the device and instruments for monitoring pressure, flow and electrical conductivity of water

The control parameters are fully consistent with the control parameters in the first embodiment.

References and patent-licensed materials:

Attachment 1

United States Patent Application	**20100071350**
Kind Code	**A1**
Tronel; Frederic	**March 25, 2010**

INTERNAL COMBUSTION ENGINE EXHAUST SYSTEM EQUIPPED WITH POLLUTION REDUCTION SYSTEMS

Abstract

Exhaust system for an internal combustion ***engine*** (1) of a motor vehicle which is equipped with a first oxidation catalytic converter or precatalytic converter (4) positioned near the outlet of gas from the ***engine,*** and with a particulate filter (9) associated with a second oxidation catalytic converter (8) these being positioned downstream of the precatalytic converter. It comprises first means for generating an increase in the temperature of the gases leaving the ***engine*** (1), second means for generating an exothermal reaction in the precatalytic converter (4) and third means (5) for generating an exothermal reaction in the catalytic converter (8) so as to split the burden of generating the increase in exhaust gas temperature required for regenerating the particulate filter (9) between the ***engine,*** the precatalytic converter and the catalytic converter.

Attachment 2

United States Patent Application	**20150285161**
Kind Code	**A1**
Ulrey; Joseph Norman ; et al.	**October 8, 2015**

METHOD AND SYSTEM FOR ENGINE CONTROL

Abstract

Methods and systems are provided for using compression heating to heat a cylinder piston before cylinder combustion is resumed. Cylinder heating is achieved using combinations of slow unfueled ***engine*** rotation where the ***engine*** cylinders are heated via compression stroke heating, and slow compressor rotation where the cylinders are heated via compression heating. One or more intake or exhaust heaters may be concurrently operated to expedite cylinder heating.

Attachment 3

United States Patent Application	**20170306858**
Kind Code	**A1**
Ulrey; Joseph Norman ; et al.	**October 26, 2017**

METHOD AND SYSTEM FOR ENGINE CONTROL

Abstract

Methods and systems are provided for using compression heating to heat a cylinder piston before cylinder combustion is resumed. Cylinder heating is achieved using combinations of slow unfueled ***engine*** rotation where the ***engine*** cylinders are heated via compression stroke heating, and slow compressor rotation where the cylinders are heated via compression heating. One or more intake or exhaust heaters may be concurrently operated to expedite cylinder heating.

Attachment 4

United States Patent Application	**20120186560**
Kind Code	**A1**
LUND; Morten A.	**July 26, 2012**

HOMOGENIZING ***FUEL*** ENHANCEMENT SYSTEM

Abstract

A homogenizing ***fuel*** enhancement system involves at least one circulation loop existing outside of the injection system for continuously circulating and maintaining the homogeneity of a multi-***fuel*** mixture apart from any demands by or delivery to the ***engine's*** injection system (whether mechanical injection or a common rail), and at least one infusion tube configured within the at least one circulation loop for providing a volumetric expansion wherein the ***fuel*** mixture is infused and thereby rendered more homogeneous.

Attachment 5

United States Patent Application	**20070089704**
Kind Code	**A1**
Jacobsson; Lisa Marie ; et al.	**April 26, 2007**

Homogeneous charge compression ignition engine control

Abstract

A method is shown for operating an internal combustion ***engine*** having a combustion chamber with a piston, the internal combustion ***engine*** capable of injecting ***fuel*** into the combustion chamber multiple times during a cycle, the method comprising: performing a first ***fuel*** injection after approximately -25 crank angle degrees after top dead center and before approximately 15 crank angle degrees after top dead center; and performing

a second ***fuel*** injection at least 5 degrees after the start of the first ***fuel*** injection and less than approximately 25 crank angle degrees after the start of the first ***fuel*** injection.

Attachment 6

United States Patent Application	**20040177837**
Kind Code	**A1**
Bryant, Clyde C.	**September 16, 2004**

Cold air super-charged internal combustion engine, working cycle & method

Abstract

Working cycle for internal combustion engines, with methods and apparatuses for managing combustion charge density, temperature, pressures and turbulence (among other characteristics). At least one embodiment describes a supercharged internal combustion ***engine*** in which a supercharging portion of air is compressed, cooled and injected late in the compression process. A sub-normal compression ratio or low "effective" compression ratio initial air charge is received by a combustion chamber on the ***engine*** intake process, which during compression produces only a fraction of heat-of-compression as that produced by a conventional ***engine***. During compression process, dense, cooled supercharging air charge is injected, adding density and turbulence above that of conventional engines with low "effective" compression ratio for this portion of air charge also. Compression continues and near piston top dead center, the air charge being mixed with ***fuel*** is ignited for power pulse followed by scavenging.

Attachment 7

United States Patent Application	**20080209900**
Kind Code	**A1**
Demura; Takayuki ; et al.	**September 4, 2008**

Exhaust Purification System for Internal Combustion Engine

Abstract

In an exhaust purification system that purifies exhaust from a plurality of cylinder groups of an internal combustion ***engine,*** an exhaust passageway (1,51) from each cylinder group is divided into a plurality of passageways (2a, 2b, 52a, 52b/3,53). With regard to one or more of the divided exhaust passageways (3,53), the amount of exhaust passing therethrough is reduced so as to reduce the heat release to the outside from the

exhaust as a whole. In this manner, the temperature of exhaust introduced into an exhaust purification device (4,54) is kept at high temperature.