Технічні науки

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PREPARATION OF GASEOUS FUEL MIXTURES

Inventions in the field of preparation of gaseous fuel mixtures, allowing to obtain stable combustion in a constant volume of the torch

Summary. *All specialists in the field of internal combustion engines had to deal with the key problem of these engines - low efficiency; The reasons for this phenomenon are also well known - the imperfection of the mechanism for converting reciprocating motion into rotary motion;*

It would seem that since the causes of power losses are in the mechanical motion conversion systems, then replacing such a mechanism with a more efficient one should resolve this technical contradiction;

Over the last year alone, several thousand technical solutions have been announced in this area, but investors are in no hurry to take advantage of them;

The combustion cycle of the fuel mixture in the cylinders of a modern internal combustion engine (Otto cycle) has been brought to complete perfection, its real efficiency on serial internal combustion engines has been brought to 98%, which means that during the implementation of the combustion cycle, 98% of the energy contained in the fuel is extracted;

This result is achieved to a large extent due to the design of the fuel system, which has been developed to almost complete perfection, and the associated system

of combustion chambers in the engine cylinders, in which combustion today occurs due to combustion at constant pressure.

Key words: *Gaseous fuel mixtures, Stable combustion, Constant flame volume, Internal combustion engines, Efficiency, Technical contradiction, Fuel mixture combustion cycle, Combustion cycle implementation, Conversion of reciprocating motion into rotational motion, Distortion of Otto cycle conditions, Vortex mixing of combustible gas, Vortex mixing of combustible gas in a vortex generator, Geometry of tangential channels.*

Fig. 1. The figure shows a vortex generator that forms a vortex tube in a flow of combustible gas

Introduction. All specialists in the field of internal combustion engines had to deal with the key problem of these engines - low efficiency; The reasons for this phenomenon are also well known - the imperfection of the mechanism for converting reciprocating motion into rotary motion.

It would seem that since the causes of power losses are in the mechanical motion conversion systems, then replacing such a mechanism with a more efficient one should resolve this technical contradiction.

Over the last year alone, several thousand technical solutions have been announced in this area, but investors are in no hurry to take advantage of them.

What are the reasons?

Let's consider one of these reasons.

The combustion cycle of the fuel mixture in the cylinders of a modern internal combustion engine (Otto cycle) has been brought to complete perfection, its real efficiency on serial internal combustion engines has been brought to 98%, which means that during the implementation of the combustion cycle, 98% of the energy contained in the fuel is extracted

This result is achieved to a large extent due to the design of the fuel system, which has been developed to almost complete perfection, and the associated system of combustion chambers in the engine cylinders, in which combustion today occurs due to combustion at constant pressure.

As practice has shown, any known changes to the design of the cylinder-piston group of the engine lead to a distortion of the Otto cycle conditions, which ultimately leads to a decrease in mechanical losses and a decrease in the efficiency of extracting energy obtained from the combustion process.

It would seem that the innovative development of this category of technology could be slowed down because of this, but fortunately this is not happening.

Where is the innovative way out of this situation, and does it even exist?

As it turns out, there is such a way out;

It is known that when combustion occurs in a constant volume of flame, energy output increases by 20%.

That is, without changing the design of the injectors and the volume and configuration of the combustion chamber, only by monitoring and regulating the volume of the combustion chamber and the volume of the flame torch in it can the required result be achieved.

Let us consider a model of conditions for obtaining combustion at a constant torch volume for gaseous fuel

Vortex mixing of combustible gas in a vortex generator;

(VORTEX DYNAMIC MIXING OF GASEOUS MEDIUMS IN VORTEX DYNAMIC MIXING AND ACTIVATION DEVICE; ADDITIONAL EXPLANATIONS)

Linear flow velocity (LINEAR VELOCITY OF STREAMS)

The flow of natural gas moves in the central opening of the vortex generators under a certain pressure and with a certain linear velocity

A stream of compressed air is introduced into the natural gas stream from the tangential channels of the vortex generator at a speed at least three times greater than the linear speed of the natural gas stream.

In this case, the pitch of the spiral in the formed vortex tube is equal to the linear velocity of the natural gas flow.

In this case, the linear velocity in the outer boundary layer of the vortex tube is greater than the linear velocity in the inner boundary layer of the vortex tube.

Since all the flows that form the vortex tube move perpendicular to the flows of natural gas, they collide repeatedly and, since the linear velocity of the compressed air flows exceeds the linear velocity of the natural gas flows

The indicated collisions, with high kinetic energy of the flows, form a developed turbulent state, which turns into Brownian motion (Brownian movement of the mix components)

Since ideal combustion conditions for natural gas require a mixing ratio of 17.2 to 1, which means there are 17.2 air molecules per molecule of natural gas, meaning there are 17.2 more gas molecules with a higher kinetic energy level entering the mixture

Due to this circumstance, the molecules of natural gas, which are lighter, are surrounded by molecules of air, which are heavier, and which, having a higher level of kinetic energy, are more mobile in the Brownian system. movement of the mix components and surround on all sides of the three-dimensional model of the mixture of natural gas molecules

Pressure V PRESSURE IN THE STREAMS

The natural gas flow moves in the central hole of the vortex generators with a certain pressure

The level of this pressure determines the pressure of the medium in the central hole of the vortex generators.

Compressed air is supplied to vortex generators under pressure ranging from 2 to 20 bar.

When moving through tangential channels with a small cross-section and parallel walls, the speed of movement of compressed air flows increases sharply and, accordingly, the pressure in the flow drops

At the outlet of such channels, the pressure in the air flows coincides with the pressure in the natural gas flow.

When moving along tangential channels with a variable cross-section, at the entrance to the central opening of the vortex generators, expansion occurs and the pressure in the integral flow acquires the pressure level in the natural gas flow

Geometry of tangential channels (TANGENTIAL CHANNELS GEOMETRY)

Vortex generators use two types of tangential channels

Tangential channels with variable cross-section are used when it is necessary to obtain the maximum possible effect - the Joule-Thomson effect (JOULE - THOMSON)

Tangential channels with equal cross-section along the entire length are used when the efficiency of the JOULE – THOMSON, RANQUE – HILSCH effects are not of fundamental importance and it is necessary to obtain a high local (BERNOULLI) Bernoulli effect

Formation of the local Bernoulli effect (LOCAL BERNOULLI EFFECT CREATION)

The level of the local BERNOULLI effect is determined by the ratio of the cross-sectional area of the pipeline for supplying compressed air to the cross-sectional area of the tangential channel

For example, with a ratio of the cross-sectional area of the channels as 1 to 15, the linear velocity of the flow in the tangential channel increases by 15 times, and with a decrease in the pressure level, also by 15 times

At the same time, due to the increase in the linear speed of movement, the level of kinetic energy increases proportionally to the increase in the linear speed.

The nature of Brownian motion in gas mixture flows (BROWNIAN MOVEMENT CHARACTER IN GASEOUS MIX STREAM)

From the moment of entering high-speed flows of compressed air into the flow of natural gas moving in the central opening of the vortex generators, the phenomenon of formation of BROWNIAN occurs MOVEMENT CHARACTER in the environment of two miscible gaseous media

Compressed air flows are accelerated in the tangential channels of vortex generators to a linear velocity at least three times greater than the linear velocity in a natural gas flow.

The flow from each of the tangential channels is directed perpendicular to the direction of movement of the natural gas flow along a tangent to the outer diameter of the central opening of the vortex generators and has a kinetic energy at least three times greater than the kinetic energy of the natural gas flow.

Air molecules with higher kinetic energy push natural gas molecules apart and enter the flow, causing a chain reaction of collisions between air and natural gas molecules.

More mobile air molecules surround the natural gas molecules and, as they move further along the spiral in the vortex tube, create a complex movement in which the molecules of natural gas and air have a common linear nature of movement along the vortex tube and, at the same time, within the framework of this movement, they move in other directions until they collide with other molecules standing in their path.

In this case, the resulting movement of the mixture in the vortex tube is subject to the laws of physics and the conditions formed by the geometry of the relationships of the elements of the vortex generators.

As a result of the sequential mixing of gas environments, after repeating the process on each of the vortex generators of the system, a uniform flow of a mixture of natural gas with aerodynamically active air is obtained, with precise observance of the proportions between natural gas and air necessary for an ideal combustion process.

The level of kinetic energy of the mixture is increased proportionally to the number of vortex generators according to the following logical model: at the input, the kinetic energy of the natural gas flow is supplemented by the kinetic energy of the air flows and an integral level of kinetic energy is formed, which is the starting level for the next vortex generator, and so on.

Clean and cooled exhaust gas (CLEAN AND COOL EXHAUST GAS)

With complete and optimal combustion, the exhaust gases do not contain incomplete combustion products.

The proposed composition and active aerodynamic structure of the mixture allow, simultaneously with optimal combustion, to obtain a decrease in the temperature of the exhaust gases, which helps to eliminate the formation of toxic substances and compounds in the exhaust gases.

Efficient and economical combustion (EFFECTIVE AND SAVENESS BURNING)

A homogeneous mixture of natural gas and air is sent from the dynamic vortex mixing device to the combustion chamber, having precise proportions between the components and in which, due to the high kinetic energy and constant movements of air molecules around heavier molecules of natural gas, the structure of the volume of the mixture is maintained and renewed, in which the molecules of natural gas are surrounded by molecules of air.

In addition, microscopic water droplets or water vapor molecules are also evenly distributed among the air molecules.

The combustion process of the specified pre-prepared mixture takes place under optimal conditions, with complete combustion of the carbon and hydrogen parts of natural gas, at a high combustion rate, at a high rate of flame front propagation, at a high level of flame stability and the entire combustion process

The specified mixture during combustion allows eliminating losses of natural gas due to inefficient combustion in zones of non-uniform mixing, since these zones do not exist in the specified mixture;

Fig. 2. Standard Flame Torch

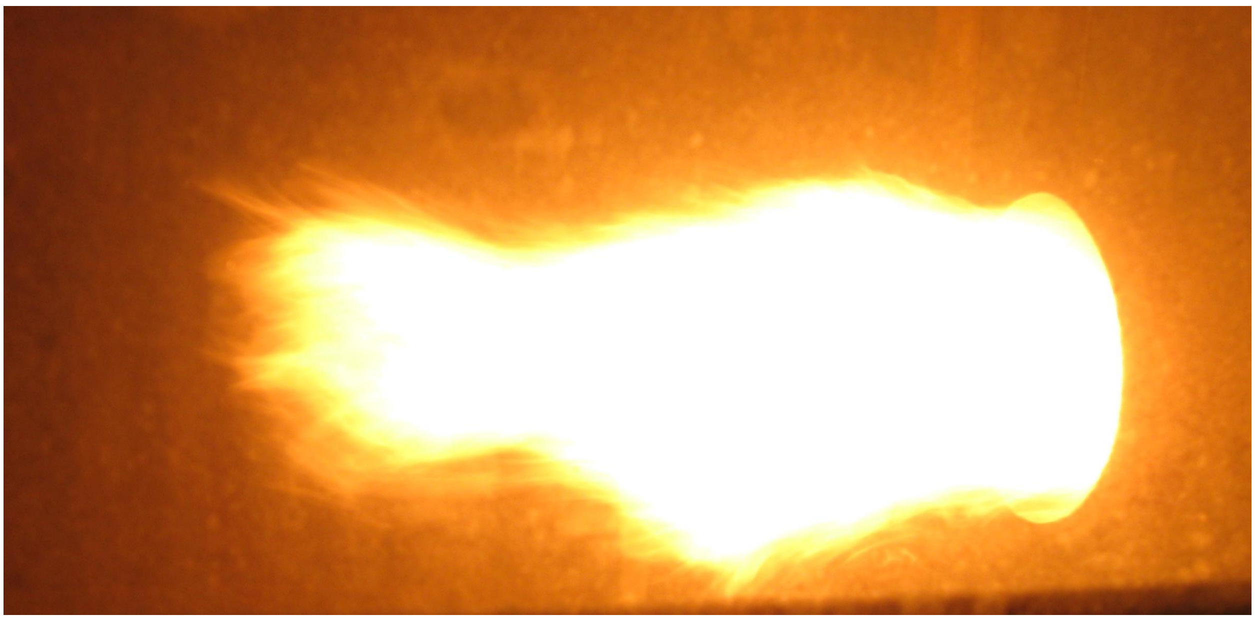

Fig. 3. Modified flame torch based on a vortex tube

Explanations and illustrations (ILLUSTRATIONS)

The explanation is illustrated by the fact that the aerodynamic design of the vortex generator is multifunctional, and in addition to mixing, it has the goal of cooling the flows of mixed gases and lowering the temperature of the mixture;

The vortex generator uses and applies a scheme of sequential local formation of the BERNOULLI, JOULE - THOMSON, RANQUE - HILSCH effects for use in dynamic mixing and sequential step-by-step cooling in flows of mixed components of gaseous media and the resulting mixture of gaseous media;

The aerodynamic scheme of sequential local formation of the BERNOULLI, JOULE – THOMSON, RANQUE – HILSCH effects allows for enhanced formation of the BERNOULLI effect to increase the linear velocity of the compressed air flow, which ensures uniform homogeneous mixing of the mixture components, while maintaining the Brownian movement of the mix components

Let us give another typical example of the formation of conditions for the implementation of the combustion process in a constant volume, which is:

- Increasing the specific power of an internal combustion engine in relation to the amount of fuel consumed, using fuel mist - a fuel composite obtained by dynamically mixing hydrocarbon liquid fuel with a compressed gaseous oxidizer...

a) If gasoline is used as fuel for the internal combustion engine:

A homogeneous mixture of gasoline with compressed air, in which the compressed air (at a pressure of at least 5 atmospheres), in the form of bubbles no more than 50 microns in diameter, is uniformly distributed throughout the volume of gasoline, in such a way that, due to the forces of surface tension, the gasoline forms a shell around the air bubbles

The volume of compressed air in the resulting mixture is more than 200 times greater than the volume of gasoline and its quantity is sufficient for optimal combustion.

The mixture has compressibility properties.

When injected into the engine cylinder, the proportions and ratios in the volume of the mixture do not change, due to the fact that the diameter of the bubbles with shells does not exceed 20-40 microns, due to the minimal size and compressibility, the mixture does not change its properties and geometric proportions during injection;

After injection into the cylinder, the pressure in which at the moment of injection is practically equal to atmospheric pressure, an adiabatic expansion of air occurs inside the bubbles, proportional to the difference in pressure inside the bubbles and in the cylinder.

The expanding air breaks the bubble shells into small fragments no larger than 3-5 microns and evenly envelops these fragments, while maintaining the volumetric proportions between gasoline and air sufficient for optimal combustion.

The entire process of converting the mixture - fuel composite into fuel mist, in which gasoline particles of 3 - 5 microns in size are uniformly mixed with a volume of air sufficient for optimal combustion, takes no more than 0.001 seconds.

Thus, ignition can be carried out immediately after the injection is completed and, due to the fact that time is not required for mixing gasoline with air, injection and subsequent ignition of the fuel mist are carried out at a time when the engine's motion conversion system is not in one of the dead points, in which at least 60% of engine power is lost.

Conservatively, the use of fuel mist with the properties described above can reduce power losses by 45-50%, and accordingly increase the specific power obtained per 1 gallon of gasoline.

b) If diesel fuel is used as fuel for a diesel engine:

A homogeneous mixture of diesel fuel with compressed air, in which compressed air (at a pressure of at least 5 atmospheres), in the form of bubbles no more than 50 microns in diameter, is uniformly distributed throughout the volume of diesel fuel, so that, due to the forces of surface tension and high viscosity, the diesel fuel forms a shell around the air bubbles

The volume of compressed air in the resulting mixture is more than 200 times greater than the volume of diesel fuel and its quantity is sufficient for optimal combustion.

The mixture has compressibility properties.

The mixture – fuel composite – is fed into the high-pressure pump, from where it is injected into the diesel engine cylinder in an even more compressed form.

When injected into the cylinder of a diesel engine, the proportions and ratios in the volume of the mixture do not change, due to the fact that the diameter of the bubbles with shells during formation does not exceed 20-40 microns, and in a high-pressure pump, with strong compression, the size of the bubbles with shells is further reduced to 15-20 microns;

Due to its minimal dimensions and compressibility, the mixture does not change its properties and geometric proportions during injection;

After injection into the cylinder of a diesel engine, the pressure in which at the moment of injection is significantly less than in the bubbles, an adiabatic expansion of air occurs inside the bubbles, proportional to the difference in pressure inside the bubbles and in the cylinder of the diesel engine.

The expanding air breaks the bubble shells into small fragments no larger than 2-4 microns and evenly envelops these fragments, while maintaining volumetric proportions between diesel fuel and air sufficient for optimal combustion.

The entire process of converting the mixture - fuel composite into fuel mist, in which diesel fuel particles of 2 - 4 microns in size are uniformly mixed with a volume of air sufficient for optimal combustion, takes no more than 0.001 seconds.

Thus, compression in the cylinder and ignition can be carried out immediately after the injection is completed and due to the fact that time is not required for mixing diesel fuel with air, injection and subsequent compression and ignition of the fuel mist are carried out at a time when the motion conversion system in the diesel engine is not in one of the dead points, in which at least 50% of the diesel engine power is lost.

Conservatively, the use of fuel mist with the properties described above can reduce power losses by 40-45%, and accordingly increase the specific power obtained per 1 gallon of diesel fuel.

c) If natural gas is used as fuel for the internal combustion engine:

Before injection into the engine cylinder, natural gas and compressed air form a vortex tube in a vortex dynamic mixing device;

In this vortex tube, the natural gas flow is homogeneously mixed with cooled compressed air in a volumetric ratio of 9.7 to 1, and after mixing, the mixture - a fuel gas composite - is completely ready for combustion and does not require additional air.

The mixture, after leaving the hermetically sealed space, retains the state and proportions obtained during its formation in the vortex tube for more than 3 seconds.

Since the mixture is completely ready for ignition at the moment of injection, injection and ignition are performed at the moment when the engine's motion conversion mechanism is not in one of the dead points, and thus eliminate or reduce engine power losses to overcome dead points, which in a conventional engine can reach 60% or more.

This fact allows to reduce power losses for overcoming dead points by 45 – 55% and to increase the specific power developed by the engine per 1 cubic foot of natural gas in the same proportion.

But there are also known design solutions in which the authors assume that combustion in the cylinders will occur in accordance with the Otto cycle.

A quick analysis of the mechanics of such a solution leaves no doubt that it is very difficult or even impossible to build such an engine.

It is felt that the author of these inventions does not have such deep experience in creating crankless engines as multidisciplinary specialists in the field of smart technologies have.

List of references, patent and license information:

United States Patent Application	**20070062469**
Kind Code	**A1**
Yaknis ; Leonid	**March 22, 2007**

Rotary radial ***combustion internal*** piston ***engine***

Abstract

The ***engine*** comprises a housing, a rotor having a driven shaft fastened thereon, which is mounted on the bearings spaced coaxially apart in the opposite sides of the housing and rotates about its axis of rotation and has a pair radially opposite cylinders spaced in the body of the rotor eccentrically and equidistantly relative to its axis of rotation. One radially outer end of each cylinder is closed by the wall and the other end is closed by piston which slides within the cylinder. Gas intake and gas exhaust may take place through the ducts in the body of the rotor extending from the cylinders to the inner pipe port of the driven shaft. There is a ***rotary*** ring mounted on the bearings spaced coaxially apart in the opposite sides of the housing. It rotates about its axis of rotation spaced apart from the rotor axis by an eccentricity and being impelled to rotate in the same direction and with the same velocity relative to the rotor by pins of the rotor. The pistons are connected to the ***rotary*** ring through the connecting rods.

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Serial No.: **227553**
Series Code: **11**
Filed: **September 16, 2005**

United States Patent Application **20100186707**
Kind Code **A1**
Yaknis ; Leonid **July 29, 2010**

High-torque rotary radial ***internal combustion*** piston ***engine***

Abstract

The ***engine*** under US Pat. No. 7,421,986 comprises a pair radially opposite cylinders spaced in the plain of the working cylinders of the above ***engine*** coaxially apart in the opposite sides of the rotor along the axis being perpendicular to the above said cylinders axes and to the rotor axis and extends cross a rotor axis. There are a pistons spaced in each of said cylinders for displacement along the cylinder axis. Each of the said piston is connected respectively to the ***rotary*** ring by crankshaft. The pressure in all above cylinders afford resultant torques which act on the rotor and on the ***rotary*** ring and the balance of all resultant torques on the driven shaft ensure high affectivity of the novel ***engine.***

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Serial No.: **321987**
Series Code: **12**
Filed: **January 29, 2009**

United States Patent	**7,421,986**
Yaknis	**September 9, 2008**

Rotary radial combustion internal piston engine

Abstract

The engine comprises a housing, a rotor, which is mounted in the housing for rotation about its axis. The rotor has a pair radially opposite cylinders spaced radially and apart from its axis of rotation. A piston spaced in each of the cylinders. Gas intake and gas exhaust may take place through the ducts in the body of the rotor. There is a rotary ring mounted in the housing which rotates about its axis of rotation being parallel and spaced apart from the rotor axis. The rotary ring has been connected to the pistons for rotation therewith and being impelled to rotate in the same direction and with the same velocity relative to the rotor by pins of the rotor. The pressure in the cylinders acts on the rotor being eccentric relative to the axis of rotation of the rotary ring and so affords power.

Inventors:	**Yaknis; Leonid** (Haifa, **IL)**
Appl. No.:	**11/227,553**
Filed:	**September 16, 2005**