

## DECREASE OF THE POLLUTION USING A NEW CONCEPT IN THE DESIGN OF INTERNAL COMBUSTION ENGINE

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**Abstract:** The paper describes a new method about the diminution of polluting emissions of the internal combustion engines. The method consists into designing motors which can run in one raided running. The debate analyses the base conditions necessary to be completed by the engines machines, in order to work according to the new concept. The engine machines which can realize the conditions of the new concept are the engines with free piston hydrostatic generators.

**Keywords:** Polluting emissions, thermic engine, internal combustion engine, engine with free piston.

### 1. INTRODUCTION

The pollution of the environment represents a range of detrimental changes, caused by the emission of polluting substances in the atmosphere. The polluting substances have a negative effect upon the health of people, animals and biological ecosystems. Industrial expansion and rapid population growth characteristic of the end of the twentieth century, have an unfavorable influence on the environment, exceeding the capacity of self-regulation of the natural ecosystem. Natural disasters, but especially human activities, deep disrupting the natural ecosystem, breaking and dynamic equilibrium. The effects of these disorders, accumulated over time, consisting of general climate shifts (destruction of the protective ozone layer, greenhouse effect linked to melting ice caps and raising ocean) and local (Antarctic ozone hole, climate change), and the occurrence of smog and acid rain, death of forests and affect human food chain - such as, problems of human bodies, animal and plant damage to buildings and other human achievements.

The global pollution produced by the greenhouse gases represents now one of the most complex problems of global environmental protection. The greenhouse gases (GES) participate in the modification of the atmospheric strata, having direct consequences on the Earth's temperature, process known as "global warming" or, of

late, as "global climatic change". The GES specified in the Kyoto International Agreement are: carbon dioxide, methane, nitrogen oxide, hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride.

Worldwide, current trends are developing and implementing modern technologies used to capture and sequestration of carbon dioxide. There are three main directions to reduce the concentration of carbon dioxide:

1. primary conversion process efficiency;
2. replace current energy sources with others what contain less carbon or total renunciation thereof;

3. capture and / or CO<sub>2</sub> sequestration.

Capturing concept is relatively new and there are three directions of approach:

1. Pre-combustion capture - capture before final combustion;
2. Post-combustion capture – capture of gases;
3. oxy-combustion capture - dark cycle (gas turbines and fuel);
4. catching the currents of industrial process.

The gases evacuated in the atmosphere by internal combustion engines represent a main source of pollution. Internal combustion engine emit mainly nitrogen oxides **NO<sub>2</sub>**, sulphur oxides **SO<sub>x</sub>**, carbon monoxides **CO**, carbon dioxides **CO<sub>2</sub>**, solid particles (smoke or soot), etc. At the same time, some of the emissions from the evacuated gases react in the atmosphere, forming the photo-chemical smog. The carbon dioxide **CO<sub>2</sub>**, a non-toxic

gas (3-4 %), a natural component of the atmosphere, is considered to be a polluting substance, because produces the greenhouse effect.

The negative effects of polluting emissions of the internal combustion engines, called for actions for restricting these emissions. The main actions of polluting emissions refer to research in order to find solutions of designing less polluting and more economical engines, from the fuel consumption point of view. The main achievements are: the control of burning through electronic devices and gasoline injection for the spark engines, and the electronic control of fuel injection for the compression engines. The electronic devices for control of the burning are complex systems. Their complexity arises from the fact that the working conditions of the existing engines vary continuously. From here, *the concept of designing engines which work in mono-running only*, independently from the working conditions of the parts they have effect on. The engine which works in mono-running only is a more simple system and easier to control. The running conditions can be optimized more easily, in order to result an engine which emits less pollution and has lower fuel consumption. The control systems of the thermodynamic processes become simpler.

## **2. NEW METHOD**

The internal combustion engine is an engine in which the burning of a fuel occurs in a confined space called a combustion chamber. This exothermic reaction of a fuel with an oxidizer creates gases of high temperature and pressure, which are permitted to expand. The defining feature of an internal combustion engine is that useful work is performed by the expanding hot gases acting directly to cause movement, for example by acting on pistons, rotors, or even by pressing on and moving the entire engine itself.

This contrasts with external combustion engines, such as steam engines, which use the combustion process to heat a separate working fluid, typically water or steam, which then in turn does work, for example by pressing on a steam actuated piston.

The term Internal Combustion Engine (ICE) is almost always used to refer

specifically to reciprocating engines, Wankel engines and similar designs in which combustion is intermittent. However, continuous combustion engines, such as Jet engines, most rockets and many gas turbines are also internal combustion engines.

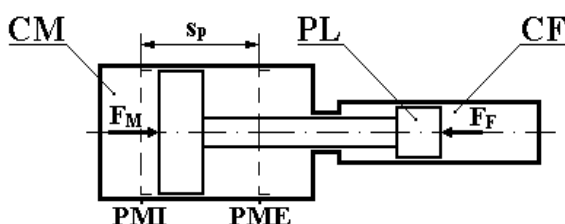
The basic element of the propulsion systems is the engine, which has the role of changing the thermo energy, achieved by burning of a fuel, into mechanic energy, generally as a rotary motion. The transmission of the mechanic energy to the working parts (the wheels of the car, etc.) is usually made through mechanic or hydraulic transmission, *in a direct way*. In order to realize a stable engine running, it is necessary that the energy flow transmitted by the engine be equal to the energy consumed by the working parts of the system. But, because usually the energy consumed by the working parts of the system varies, the result is that the energy flow of the engine must be varied. This is the reason why the present engines have devices for varying the energy flow, called regulators. The greater the energy flow from the propulsion system, the harder the engine runs, having negative consequences on energy consumption and durability.

In order to eliminate these disadvantages, *the author suggests a new concept regarding engine designing*, [1]. The concept presumes to work out engines made mainly of an energy generator, energy accumulator and engine machine, in which two kind of energy transformation take place, a primary one and a secondary one. The primary one is realized by the energy generator, which transforms the input energy in another form of energy (different from mechanic energy) and transmits it to the accumulator. The secondary one is realized by the engine machine, which takes over the energy from the accumulator and transforms it into mechanic energy, generally as a rotary motion. The way the engine works is the following): the energy generator (**GE**) transforms the input energy (thermic) in another form of energy (hydrostatic, pneumatic) and providing the produced energy for the energy accumulator (**AE**) until the amount of energy in the accumulator reaches the maximum. At that moment, the generator (**GE**) automatically stops working, until the energy from the accumulator drops to the minimum admitted amount. In this way,

the generator (**GE**) works automatically, in one running, obviously in the most advantageous way, independently from the engine machine (**MM**). When the generator has the cycle formed by resistant strokes (compression, evacuation, etc.) the course of energy flow may be both way, generator-accumulator and accumulator-generator. The machine (**MM**) takes over the energy from the accumulator and transforms it in mechanical energy, depending on the consumption realized by the working parts of the system. The course of energy flow may be both way, accumulator-engine machine, and engine machine-accumulator, if the engine machine is reversible. In this way, the kinetic energy for braking may be re-transformed and stored in the accumulator.

The generator (**GE**) must perform the following duties: *produce a form of energy which can be easily stored* by the energy accumulator (**AE**) and to be easily transmitted to the engine machine (**MM**); *work in one raided running*, automatically, based on the principle “all or nothing”, meaning to start automatically delivering energy to the accumulator, when the accumulator’s energy level is at its minimal allowed limit, and stop automatically when the energy in the accumulator is at its maximum allowed limit. The types of energy which fulfill these conditions are the *hydrostatic energy* and the *pneumatic energy*. The hydrostatic energy may be used for a large range of powers and many domains.

The generators which can fulfill the previous stated conditions are generators with free pistons (**fig. 1**). The generators with free pistons are made of two cylinders, the motor cylinder (**CM**) and the fluidic cylinder (**CF**), coaxially assembled in the interior of which the free piston (**PL**) can move linear-alternatively, which is the only mobile part of the generator and is not joined with other elements.



**Figure 1: Generators with free pistons scheme**

The repeated start-stop of the piston at the end of the course doesn't affect the engine machine, because the speed and the kinetic energy of the piston is zero at the end of the course. This phenomenon cannot be realized on machines which have mobile joined elements because of the acceleration-braking moments, when start-stop there is a loss of energy. The movement of the piston is made by the force from the  $F_M$  motor cylinder, called motive force and the force of the fluidic cylinder  $F_F$ . the motive force  $F_M$  is realized by the pressure of the burning gases, obtained through the burning of a fuel (gasoline, petroleum). The force from the fluidic cylinder  $F_F$ , represents the pressure force of the fluid which generates the energy, which is materialized through a liquid or gas.

### 3. RESULTS AND DISCUSSION

The propulsion systems operated by engines with free pistons, designed according the new concept, have the following advantages: simple design, having the possibility to divide to each working part of a hydraulic or pneumatic engine, in this way the mechanic transmission can be removed; we estimate a more technical and viable system, compared to the present ones; low fuel consumption, because the generator of the engine works one raided only, with the less fuel consumption and doesn't run empty; the possibility of recovering the braking energy of the working parts, because the motor element (**MM**), is a reversible engine; we estimate the diminishing of the fuel consumption with 50-60% compared to the present systems; the possibility of the diminution of polluting emissions to international standards, without the need of complex electronic devices; the new engines, designed according to the new concept may be used to a large range of mobile propulsion systems, of great work complexity, because the engine element (**MM**) is a reversible machine

### 4. CONCLUSIONS

It is recommended the re-directing of the research concerning the diminution of polluting emissions and of fuel consumption of the internal combustion engines towards engines which work one raided. In this way, we can realize making less effort and more efficiently, the conditions assigned for the

internal combustion engines concerning the diminution of polluting emissions and of fuel consumption.

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