

New Direction of Engine Research and Resulted from the Trend Engine, the Efficiency of which Matches Efficiency of Carnot Engine

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ABSTRACT

This presentation identifies numerous causes of the inefficiency, which have been handed down from one generation of engines to another since Otto patented the first engine in 1876. As the faults are still penetrating into engines under development, it is obvious that these must result from faulty design as the design has not changed yet and it has been preserved since then. Thus the presentation proposes a new more effective direction of research that allowed author to develop engine completely free of the inherited causes of inefficiency, the efficiency of which matches that of Carnot engine. The presentation proposes much needed design changes and a new thermodynamics emerging from the proposed new design that combines a traditional engine with harmonic oscillator.

INTRODUCTION

Through over century long history of researching combustion engines, researchers have not been able to pinpoint what really causes the inefficiency in combustion engines, blaming laws of nature for lack of progress; mainly second law of thermodynamics.

Without knowing what causes the inefficiency, those directed effort rather towards improving details of the design than the faulty design, which has proved useless. Researchers have not bothered to try to change the design, because existing engines are simple and function well. It is normal that nobody wants to change what works well and is simple.

The preservation of the faulty design is the result of wrong trend of research that has been and still is the major blunder related rather to lack of understanding of the second law of thermodynamics as well as lack of identification of causes of inefficiency. How can anybody eliminate something that he does not know the something exists?

In addition to the concentration on details, researchers also have been preoccupied to prevent detonations of fuel, because the detonations devastate every existing engine, as detonation generate up to 14 times higher pressure and temperature and that devastate every existing engine.

The prevention of detonation is especially damaging to energy conversion and efficiency, because power available from used fuel is defined as energy released in time and detonation speeds up energy release up to 1000 times, which yields potential for more power from much less fuel.

The author understood that he must change the design when inventing new engine. This effort, to develop engine destined to detonate fuel, resulted from idea that detonation yields higher temperature and pressure, which are most important factors to improve engines from the energy conversion and efficiency point of view.

This presentation proposes a better trend of research that should rather concentrate on cushioning the forces of detonation, development of internal cooling that preserves heat, conversion of the preserved heat into additional useful work and plurality of power strokes resulting from single detonation of fuel

The purpose of this presentation is to:

- propose a better direction of researching engines;
- pinpoint causes of the inefficiency plaguing engines;
- propose methods to eliminate, or minimize, the pinpointed causes of inefficiency;
- propose a concept to re-design engine to eliminate inherited faults of the XIX century design;
- provide a prove that today's trend is wrong by providing such a fully fuel flexible engine, which delivers more power from less volume of cylinder and with less fuel consumption as well as zero toxic emissions and negligible GHG emissions not higher than 5% of these of diesel engine;

CAUSES OF INEFFICIENCY PLAGUING PRIOR ART ENGINES

To identify causes of inefficiency the author analyzed the design of Diesel's patent applications [1] & [2]. The analysis allowed author to identify major causes of inefficiency related to design flows as follow:

There are many causes of the inefficiency plaguing every prior art engine, but the most important is the incomplete expansion of the exhausts. This cause is most important, because the exhausts when expanding produce useful work and cool at the same time. The incomplete expansion converts only a small part of heat energy released from fuel into useful work and the rest of the heat accumulate in internal parts, so this energy must be disposed or the engine melts down. Therefore every existing engine is rigorously cooled and today's cooling is the major cause of the inefficiency in every existing engine. This invention (patent pending) has eliminated this major cause of the inefficiency, as it expands exhaust completely i.e. below atmospheric pressure thus it does not need external cooling that wastes heat.

Torque is defined as force acting on distance, so to maximize torque the max pressure should occur when crank is horizontal. But in today's engine the max pressure occurs when crank is aligned with the centerline of cylinder thus the distance is zero at this moment, so is the contribution to torque and power output. Therefore the highest potential to produce work is wasted on wearing of parts, which yields another cause of the inefficiency and acceleration of deterioration of parts. The new design has eliminated these faults, because the maximal pressure meets horizontal crank in the invented engine and stress relates only to load.

Properly tuned prior art engine has to ignite fuel about 10 to 40 degrees prior to TDC and this advancement of ignition depends on its actual speed of turning as well as the speed of burning fuel. This is another cause of the inefficiency, because it generates pressure acting on piston prior to TDC, which counteracts rotation as unnecessary breaking. This new design has eliminated the advancement of ignition and the resulted breaking, which is yet another cause of the inefficiency, because in this invention the detonation of fuel should occurs precisely at TDC.

Fuel supplied into cylinder of every existing engine is as a mist comprised of tiny little droplets hanging in air. Some of the droplets forming mist, when in contact with very hot internal parts, split into carbon and hydrogen. Resulting hydrogen combusts fast and complete, but carbon combusts neither fast nor completely. The not burnt portion of carbon deposits on internal parts as black engine deposits or it is released with exhaust as black particulates poisoning the environment. The split wastes up to 6 % of used fuel and during starting the waste of fuel could be as high as 12%. Both, the deposits and black particulates are carcinogenic compounds causing

health hazards. Also the black particulates, when inhaled can penetrate through lung tissues into blood stream, which activates immune response that causes clotting, sometimes leading to heart attacks or strokes that can directly cause death of the victims of emissions. This invention eliminated this cause of inefficiency as well as the resulting health hazards because it uses fuel vaporization, which prevents the split.

Power available from consumed fuel is defined as energy released from fuel in time. Due to the way the fuel is supplied into cylinder, every prior art engine releases energy from fuel relatively slow, thus power available from consumed fuel is much lower than it should be. This is yet another cause of the inefficiency. The new design allows release of energy from fuel up to thousand times faster, thus the new design eliminated this cause of the inefficiency.

Even though it is possible to speed up the energy releases by detonation, every researcher makes effort to prevent detonations, because existing engines could not withstand explosions of fuel that yield about fourteen times higher pressure and temperature, which indicates that the purpose of the research is an unintentional prevention of development of efficient engines.

Even though it is possible to strengthen parts, so these could withstand higher pressure, the temperature increase presents a real problem. It presents problem because piston is the worst cooled part in every existing engine, so the crown of piston melts down. This invention is destined to detonate fuels, thus eliminated this causes of destructions. This presentation proposes to re-design faulty prior art engine, thus it provides such an engine in which releasing energy from fuel is up to 1000 times faster, while its efficiency matches that of the ideal engine sometimes referred to as Carnot engine.

While every existing engine expands exhausts incompletely, it also has only one power stroke resulting from single release of energy from fuel. Thus the most of the heat energy released from fuel is wasted through release of hot exhausts and cooling. The new design provides solution to this waste of heat energy, because the proposed engine produces up to six power strokes (resulting from each single detonation of fuel) thus the work production lasts until no heat energy is left in the exhaust. Therefore when the exhaust temperature has dropped below 140 F degree (experimental data) then and only then this cool exhaust is released, which assures complete energy conversion;

Every existing engine operates only on one fuel and the author considers that a fault, because the owner of engine cannot select the most economic fuel on the market. The proposed new design allows using of every available fuel, because the new design incorporates automatic adjustment of compression ratio to any fuel octane;

Due to mentioned ignition advancements, every existing engine has Torque vs. Speed characteristics that prevent effective operation at low speeds. Thus every car, truck etc. employs a transmission or reduction gears to initiate movement of heavy load and that adds another cause of the inefficiency, because transmission has its own inefficiency and energy losses. This new design eliminated need to employ energy wasting transmission, because invented engine has flat characteristics of Torque vs. speed and its power output is linear, which means the increase of power output is in proportion to fuel supply increase within full range of speeds.

In addition the new design improved torque as during starting up the torque is about 100 times higher than the max torque of any diesel engine, which consumes the same amount of fuel. The so high torque indicates a potential to cut fuel consumption in staggering 99%.

As new design has combined a harmonic oscillator with prior art engine, the resulting combination has improved:

Thermodynamics, as higher pressure and higher temperature resulting from detonations of vaporized or gaseous fuels contribute more to energy conversion and efficiency;

Stress generation in parts lowered by design due to cushioning effect of the harmonic oscillator;

Torque production has been improved by design, because of meetings between horizontal crank with max pressure that provides about 100 times higher torque than in diesel and that indicates a potential to cut fuel consumption by 99%;

- power output improved by design due to boost of the torque;
- heat losses minimized by design, as the intentional heat losses by cooling have been eliminated;
- mathematical model improved by design;
- real fuel consumption - cut by 95% due to better design (experimental data);
- GHG emissions cut by 95%, due to low fuel consumption (experimental data)
- synthesis of NOx eliminated (zero NOx emissions proved by experiment), due to lowering temperature rather with a superior expansion of the exhausts below the atmospheric pressure, than radiator;

NEW DESIGN

The author wrote a list of what should new design include first. The list comprises:

- To eliminate the 1. cause, the new design should allow complete expansion of exhausts;
- To eliminate the 2. cause, the new design should assure that the highest pressure meets horizontal crank position;
- To eliminate the 3. cause, the new design should eliminate need to advance the initiation of energy release from fuel thus allowing ignition precisely in TDC.
- To eliminate the 4. cause, the new design should replace the supply of fuel mist hanging in air with a fuel vapor premixed with air, thus fuel vaporizer that premixes fuel vapor with air must be included, which also eliminates the rest of listed causes of inefficiency thus all the listed inherited causes of inefficiency would be eliminated.

As unknown student, the father of Quantum Mechanics Planck had written (at the end of XIX century) a theoretical paper, in which he proved that a combination of a heat pump with Carnot engine would increase the efficiency above that of Carnot engine alone.

The author read the paper in his stormy youth and recalled its brilliancy when thinking how to improve engines, thus a thought like lightning thundered in his mind when falling asleep What device could be invented to combine with diesel engine to boost the efficiency?. A brain storm lasted through the sleepless night, but in the morning he knew well that the device should be a harmonic oscillator, so felt asleep.

After waking up, he decided to go hunting moose in the North East Rockies of British Columbia and during driving tried to imagine how the harmonic oscillator would improve the efficiency and energy conversion.

It was very short hunting. Many moose trucks, on the ground around, indicated a good opportunity to bag the beast. Soon the dark silence of the evening was broken by a sudden lightning of a loud shot that echoed the mountains. The moose was down and author was busy butchering the beast.

Then he set up a camp fire on which roasted juicy stakes and after he decided to clean the rifle. Suddenly he discovered with amaze that rifle resembles engine as:

- barrel resembles cylinder;
- bullet resembles piston;
- case of ammo resembles combustion chamber;
- powder resembles fuel as it stores chemical energy like gasoline;
- primer resembles ignition;

Indeed crankshaft was missing, so the author asked himself a question what would happen if I elongate the cylinder with gun's barrel and squeeze the trigger precisely when the piston is in the TCD?

Indeed bullet cannot move instantly due to inertia thus it would accelerates squeezing air between bullet and piston. The pressure building over piston increases gradually, thus the second cause of the inefficiency has been eliminated.

Also proper selection of the mass of the bullet and amount of exploded fuel eliminates all the other inherited causes of the inefficiency, if fuel has been vaporized and premixed with air in explosive proportion.

After the air pocket has been squeezed completely the bullet re-bounces and the process reverses, which recompresses exhausts allowing additional expansion to produce additional work. The process can continue until all the energy released from fuel has been converted into useful work, thus the temperature of exhausts drops below dew point and steam resulting from reaction of carbohydrates forming fuel with oxygen condenses into fog. At that point the evacuation of exhaust should commence. The exhausts could be directed into exhaust water separator so water is recovered and collected while pure exhaust (CO₂) released. The separation of water is important as NO_x or SO_x toxins easily dissolve in water so the separation process blocks toxic emissions.

MATHEMATICS OF THE NEW DESIGN

Harmonic oscillator is a device that converts one form of energy into another back and forth, with the efficiency as high as 99.999 (9) %. There are many designs of harmonic oscillator, but the invented harmonic oscillator includes mainly two types of design, wherein the sequence of the first type comprises:

- a detonation chamber;
- a free oscillating mass
- a compressible gas pocket, preferably air pocket on which the said mass floats;

While the sequence of the second type comprises:

- a compressible gas pocket, preferably air pocket;
- a free oscillating mass;
- a detonation chamber;

In the first type, the detonation does not act on work piston at all and in the second type detonation acts on the work piston, which is the main difference between both types. The preferred is first type, but the second could be practical for retrofitting existing engines into the invented new engine technology.

There is yet another harmonic oscillator, in which the oscillating mass comprises masses of work piston and piston rod connecting to crank (an expandable / contractible piston rod), which allows cushioning and conversion of pulse of force resulted from detonating fuel into sinusoidal varying force acting on crank. Also flexible crank could do the trick as well as crankshaft that twists around the centerline of rotation - torsional oscillations.

To be within legal limit of number of pages, this analysis considers only the preferred first type.

CALCULATION OF PRESSURE RESULTING FROM DETONATIONS OF FUEL

To calculate the amplitude of pressure resulting from detonation of fuel precisely, let's consider that in a prior art engine the maximum pressure at TDC results from releasing of rather negligible fraction of energy stored in fuel - hardly exceeding 7% (as the rule of thumb).

Let's also consider that the harmonic oscillator releases 100% of energy stored in the fuel and the release occurs precisely in TDC, thus the volume of combustion chamber in prior art engine is the same as that of the detonation chamber of the oscillator. Therefore the same volumes contain different energies.

Indeed the pressure resulting from release of 100% energy would be in proportion to the release of 7% energy higher, which is described by (1).

$$(1) P_{exp\ pulse} = \frac{100\%}{7\%} \cdot p_{MAX.DIESEL} = 14.3 p_{MAX-DIESEL}$$

Thus this pulse of pressure defined by (1), would be converted by the harmonic oscillator into harmonic pressure variations that act on piston of prior art engine. The question is how the resulting pressure variations improve effective pressure acting on the piston of prior art engine?

Any harmonic oscillator could operate as:

- not damped that never exists, but is important as theoretical model;
- damped that is real;
- over-damped that is real, an example is prior art engine

The relation between trigonometric functions sine and cosine are as in (2)

$$(2) \quad SIN(\alpha) = COS(\alpha - 90);$$

As the invention uses harmonic oscillator that converts pulse of pressure into harmonic pressure variations occurring over the oscillating mass, the pressure acting on the said mass is described by (3) and the pressure acting on work piston is described by (4)

$$(3) \quad P(t) = P_{ex-pulse} \cdot \cos(\omega t);$$

$$(4) \quad P(t) = P_{ex-pulse} \cdot \sin[(\omega + \omega_{piston}) \cdot t]$$

While in the diesel engine the pressure acting on the piston is exponentially decreasing, the author has jumped to conclusion that combining engine with harmonic oscillator would improve greatly engines operation, because pressure building over work piston consisted of sinusoidal pressure variations on which traditional expansion is imposed. This delays pressure building that acts on the piston of traditional engine.

How the delay impacts torque production?

Lets consider that in prior art engine the max torque appears when crank is horizontal, but at that moment the pressure acting on piston has expanded because piston is in half of the cylinder position, the pressure has decreased by half of compression ratio number, (which is typically 14 for diesel and it is 9 for gasoline prior art engines) so pressure acting on the piston (when the crank of diesel engine positions horizontally) is defined as:

$$(5) \quad P_{crank-hor.} = P_{MAX-DIESEL} \cdot \frac{2}{r};$$

Also consider that in the invention, the max pressure is about 14.3 times higher [see expression (1)] and in addition consider that this high pressure is replicated when crank is horizontal, thus the pressure acting on horizontal piston of invented engine is defined as:

$$(6) \quad P_{cr.hor.-convert} = 14.3 \cdot P_{MAX-DIESEL} \cdot \frac{r}{2} = 101 P_{MAX-DIESEL};$$

As typical compression ratio for diesel engines is 14 and both engines have identical strokes and bore of cylinder, the max torque of invented engine is defined in relation to diesel engine as (7) providing both consume the same fuel.

$$(7) \quad T_{conv} = 101 T_{diesel}$$

Indeed to prevent robust cylinders capable to withstand detonations, the author advises rather to lower fuel supply into cylinder to only 5 % of that in diesel engine, which would still generate 7 times higher torque than the torque of diesel engine having the same cylinder bore, stroke and 100 % of fuel supply.

How combining engine with harmonic oscillator impacts energy conversion and efficiency?

As harmonic oscillator can withstand detonations, because it cushions resulting forces and in addition expands resulting exhausts immediately, which cools the exhausts fast by expansion; the analysis of energy transfer from detonation chamber to said gas pocket is described mathematically by expressions (3) & (4), thus effective pressure acting on piston is defined as root mean square (RMS) of the amplitude of sinusoidal pressure variation over piston according to well known expression (8).

$$(8) \quad \text{RMS} = 0.77 A$$

In diesel the pressure acting on piston is defined by expression (9)

$$(9) \quad P_{av.diesel} = P_{MAX-DIESEL} \int_{0\pi} e^{-\beta t} dt ;$$

As the new design combines a harmonic oscillator that converts pulses of pressure resulting from detonations of fuel into sinusoidal pressure variations, the effective pressure acting on the piston is described by (10).

$$(10) \quad P_{eff-con} = 14 p_{MAX-DIESEL} \cdot \frac{0.77}{2} \cdot \int_0^{\pi} e^{-\beta t} dt = 4.456 \cdot P_{av-diesel} \quad \{\text{See also expression (9)}\}$$

Dividing (10) by (9) we get (11), which says that the effective pressure acting on the work piston in the combination is 4.456 times higher than the average pressure acting on the work piston in diesel engine

$$(11) \quad P_{eff-con} = 4.456 \cdot P_{av.diesel}$$

Considering that the efficiency of the original Suzuki hardly exceeds 20%, the resulted efficiency of the convert is calculated using (12).

$$(12) \quad E_{convert} = 4.456 E_{diesel} = 4.456 \cdot 20\% = 89.12\%$$

As the efficiency of real engine must satisfy limits of the second law of thermodynamics, it is important to notice that detonation of fuel creates temperature about $10,000K^{\circ}$ and the combination operates in ambient temperature about $300K^{\circ}$ thus efficiency of adequate Carnot engine of convert is defined by expression

$$(13). \quad E_{adq-carnot} = \left[1 - \frac{300K^{\circ}}{10,000K^{\circ}}\right] \cdot 100\% = [1 - 0.03] \cdot 100\% = 97\%$$

Because the efficiency of combination is lower than the efficiency of ideal Carnot engine the combined engine can exist as real engine, because it has satisfied the second law of thermodynamics.

One might ask how the efficiency of the convert differs from the efficiency of the Carnot engine that relates to the original Suzuki.

As the original Suzuki yields temperature of gasoline burning about $3000K^{\circ}$ and original Suzuki operates in the same temperature as the convert, its efficiency is calculated using (13) as 90%. Therefore the author says that his invention is as efficient as the efficiency of Carnot engine related to the original Suzuki.

Modeling

The above calculations allowed electronic modeling, which was conducted by author with analogue electronic computation circuit. The selection of analogue technique was because the invention comprises only two oscillating parts: one is an ordinary engine and the other is an explosion driven harmonic oscillator, which are easily modeled with: an electronic pulse burst generator that simulates detonation; electronic oscillator forced with pulses from the pulse generator that simulates the mechanical harmonic oscillator; and over damped

electronic circuit enforced with the output from the electronic oscillator, which simulates traditional engine. Thus author managed to optimize the operation of the first prototype. The simulation would be subject of presentations to follow; perhaps author would also develop digital modeling or even hybrid based on analog and digital approach combining both.

FIRST PROTOTYPE

The above calculations and modeling encouraged the author to develop first prototype. As the funds were limited, he decided to use fiber glassing to find out if the expected energy conversion is real. If he was wrong the prototype would have melted as it would be cooled internally exclusively with superior expansion, which prevents huge energy losses plaguing every diesel and Otto engine.

The combination operated perfectly on every used fuel including hydrogen and the exhaust pipe was observed cool, so author sometimes was warming cold hands by placing them on the exhaust pipe without risk of burning hands.

He created lot of knowledge, which made him confident he could develop any size of the invented engine, even large marine propulsion for a million ton tanker with power output above 500,000 kW. Thus he confidently delivered full fuel and at the same time applied full break. The used Japanese crankshaft splintered and destroyed the first prototype. This was devastating to the marketing, but shown a superior torque at 50 rpm speed only.

CONVERSION OF EXISTING ENGINE INTO NEW TECHNOLOGY

The next step was to convert of a Suzuki three cylinder 993 ccm engine into new technology to observe impact of the harmonic oscillator on engine performance. The Suzuki was tested first and then converted. The conversion included:

- a device to vaporize fuel that also premixes resulting vapor with air in explosive proportion;
- an elongation of cylinder to accept components of harmonic oscillator;
- replacing original combustion with detonations of vaporized or gaseous fuels;
- internal cooling that preserves heat;
- conversion of preserved heat into extra work;
- variable compression ratio to allow any fuel octane;
- and many more;

The convert was placed on a dynamometer and the author decided to lower the fuel supply to only 10% of that recommended by the Suzuki manual to prevent cylinders from bursting. Nonetheless the measured power output was 40% higher than the maximum power output of the original Suzuki that was fully fueled. The conversion proved again the concept is superior to concepts of Otto or Diesel.

SUMMARY/CONCLUSIONS

In summary, the new engine has many parts similar to those of diesel, but it is different because it is destined to detonate vaporize or gaseous fuels. Yet the detonations do not act on the work piston, but rather on an additional piston that floats on a compressible air pocket over the ordinary piston. The arrangement has changed the operation and thermodynamics, because it combines harmonic oscillator with ordinary engine. The mathematical model of the new arrangement proves improvements of the resulting energy conversion and the

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efficiency by a factor of 445.6 % and that makes the new engine as efficient as equivalent Carnot engine with relation to diesel.

Cushioning tremendous forces of detonation, fast expansion of exhausts and meeting between highest pressure with horizontal crank are behind full conversion of energy released from fuel, while separation of water resulted from fuel/air reactions is behind zero toxic and negligible CO₂ emissions that does not exceeds 5% of diesel engine CO₂ emission. Also, fuel vaporization and premixing fuel vapors with air in explosive proportion is behind zero black particulates emissions as well as zero CO emissions

The presented combination of traditional engine with explosion driven harmonic oscillator does eliminate all causes of the inefficiency (hidden in poor design) infesting all existing or under development engines, that have been inherited from the first prototypes of Otto and Diesel engines invented in the XIX century;

1. While the most important cause of the inefficiency in every traditional engine is a single and incomplete expansion of exhausts that requires cooling, (to prevent melting) which is the most important cause of energy waste in every traditional engine, the proposed combination replaces the single expansion with pluralities of recompressions and expansions, induced with harmonic oscillator that allows complete energy conversion and that allows real engine to be as efficient as the ideal heat engine;
2. The harmonic oscillator requires an elongation of cylinder, of the traditional engine, to accommodate an oscillating mass component and air pocket, on which the component floats, wherein the initial pressure, in the pocket defines the compression ration of the invented combination, which could be adjusted to any needed value on the fly to assure initiation of detonation of fuel by compression heat;
3. As the combination expands exhaust completely and converts all the energy released from fuel into work, it does not need any external cooling at all.
4. To allow operation of the combination without cooling, the manipulations of valves must be independent from positions of crankshaft, therefore traditional camshaft to manipulate valves must be replaced with flexible electromagnetic or hydraulic actuators to allow variable up to 14 stroke mode of operation of the combination;
5. To allow proper monitoring of the crank position, the author advises to use a microprocessor based control fed with data from a non-contact position sensor such as optical disk or magnetic sensor;
6. Elimination of camshaft and associated gears does eliminate another cause of the inefficiency in engine;
7. Replacement of traditional combustion with rapid energy release from fuel prevents the decomposition of fuel onto carbon and hydrogen, thus eliminates by design the related fuel losses, (infesting traditional engines) black engine deposits and emissions of black particulates;
8. Impact of the mass production of the invention on oil market could be the same as decimal increases of the supply of oil and that could lead to more prosperous and peaceful World;
9. The impact would include huge annual fuel savings that in Canada is about 60 billion of liter of gasoline and 20 billions of liters of diesel and that presents monetary savings reaching almost \$100 billions/year.
10. The impact of the invention on USA economy would be the total elimination of imports of oil with annual price tag of \$1,000,000,000,000/year;
11. The saved money could be invested in profitable ventures (instead smoked out by cars and trucks) and that could lead to a never known Golden Age where every Canadian has a well paid and interesting job, access to very good Health Care, without long waiting list, and education according to interest and not economic needs.

REFERENCES

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2. Rudolf Diesel US patent No. 608,845

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I also appreciate efforts of my friend and therapist, Madame Marie Oimet, who is also an awesome inventor. I want to thank Marie because she pushed me to do something about my inventions, so I bought electronic components and assembled these into analogue computer. Then I modeled my invention. The excellent results of the modeling made her push me to develop a small prototype that proved my concept. Without her push the invention would only be a point in the list of many since I was 12. Today the list has many items with only one invention patented and 6 inventions as patent pending, mainly because I use inventing rather as intellectual pleasure and therapy to prevent depression than way of making money.

DEFINITIONS/ABBREVIATIONS

New engine: an engine that combines operation of a harmonic oscillator with traditional engine;

Explosion driven harmonic oscillator: a device enforced by detonations that converts pulse of pressure resulted from detonating fuel into harmonic pressure variations acting on work piston of traditional engine part of the new engine

Detonation: A reaction of fuel within the whole volume that contains the reaction, (detonation chamber) so no flame propagations appear, as the reaction occurs simultaneously in every point of the volume;

$P_{hopulse}$ - Pressure resulted from detonating vaporized or gaseous fuels

$P_{max-diesel}$ - Maximal pressure resulted from combusting fuel (with flame propagations) in traditional engine;

P(t) - Pressure as function of time;

α - Angle

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β - damping that represents work to overcome load, friction and other energy losses (leaks, thermal etc.);

t - Time;

$E_{convert}$ - Efficiency of new engine (converted Suzuki engine);

E_{diesel} - Efficiency of traditional engine (original Suzuki engine);

$E_{adq-carnot}$ - Efficiency of adequate Carnot engine to new engine;

$P_{ex-pulse}$ - Pulse of pressure resulted from fuel detonation;

ω - Angular speed of the additional piston (bullet piston);

ω_{piston} - Angular speed of the piston of the engine part of new engine;

$P_{crank-hor.}$ - Pressure meeting horizontal crank in diesel engine;

$P_{cr.hor.-convert}$ - Pressure meeting horizontal crank in new engine (converted Suzuki);

$P_{av.diesel}$ - Average pressure acting on piston during power stroke in diesel engine;

P_{out} - Pressure output from harmonic oscillator that acts on piston of engine part of the new engine;

e - Euler number;

π - Angle of crank turn during power stroke of traditional engine;

T_{conv} - Torque developed in new engine (converted Suzuki);

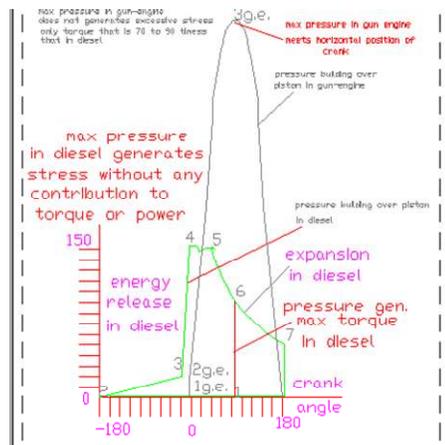
T_{diesel} - Torque developed in traditional engine (original Suzuki);

RMS - Effective value of alternating signal;

T_{comb} - Temperature resulting from combusting fuel in traditional engine (original Suzuki);

T_{det} - Temperature resulting from detonating fuel;

Comparing pressure on the piston in a diesel and new engine



The drawing presents a graph of energy release from fuel in traditional engine that produces pressure over piston of diesel engine with half sinus like pressure building over work piston in the new engine, in which the maximal pressure meets horizontal position of crank.

Notice that maximal pressure acting on piston meets the crank aligned with the centerline of the crankshaft (region 4-5 of graph of diesel engine), which creates stress without contribution to torque or power output.

Notice that pressure generating maximal torque in diesel is only 1:7 of max pressure.

Notice that max pressure in the new engine is 14.3 times higher than max pressure in diesel engine thus torque resulting is 101 times higher.

Also notice that the area 3-4 is generating negative torque in diesel engine;

Notice that there is no generation of negative torque in new engine, which is important as it eliminates causes of inefficiency inherited by diesel engine from XIX century first prototype.

The bottom left fig. is a cross-section of diesel engine when combusting fuel produced highest pressure. Please notice that the highest potential does not contribute to torque or power, but produces huge stress and that has damaging effect on parts that wear fast.

The bottom right fig. is a cross- section of diesel engine when crank positions horizontally. Please notice that at this moment the pressure acting on piston has lowered half of the compression number as piston is in half of cylinder position/

converted Suzuki at test bed



The converted Suzuki engine detonates fuel vapor or gaseous fuels, thus tests proved that gaseous fuels are more convenient than liquids as there is no need to evaporate fuel. The Acetylene proved as best fuel, because it is 50 % more energetic than gasoline.