

New timing gear for a 4 stroke engine or a new 4 stroke engine.

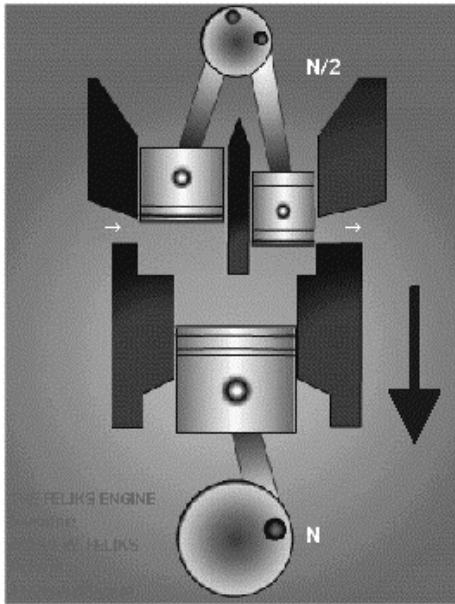
Peculiar title of this article is related to a new system of air-fuel mixture exchange in a 4 stroke engine. One will say it is a piston valve timing gear, others will say a 3 piston 4 stroke engine or call it the Feliks engine, just like the inventor's surname. While just considering the naming of this invention, You can already see that it can be viewed from many angles. At the very beginning, I tried to make a new experimental construction which was an effort to eliminate poppet valves, finally, it ended up with a very new and surprisingly good 3 piston engine. It belongs to begin for better apprehension from „pistons gear” - just as I began , and end as new engine four stroke through evolution this construction

I think that that describe of this construction are passed with purpose it belongs to visit internet part [http\\ www.new4stroke.com](http://www.new4stroke.com) ,or at least it is possible to pull off part from above mentioned animation which see.

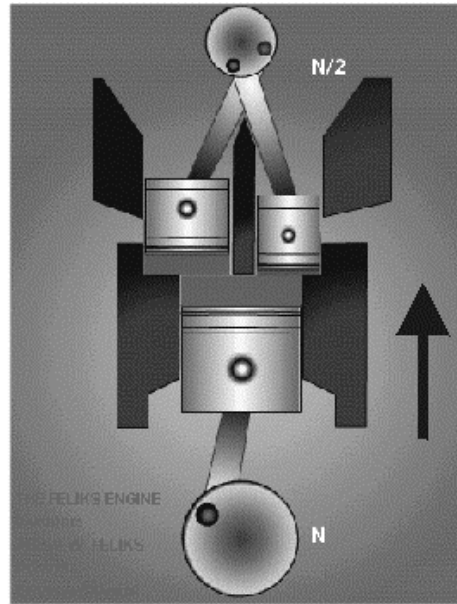
At least it is possible to print four basic phases from this animation .

Example Figure 1.

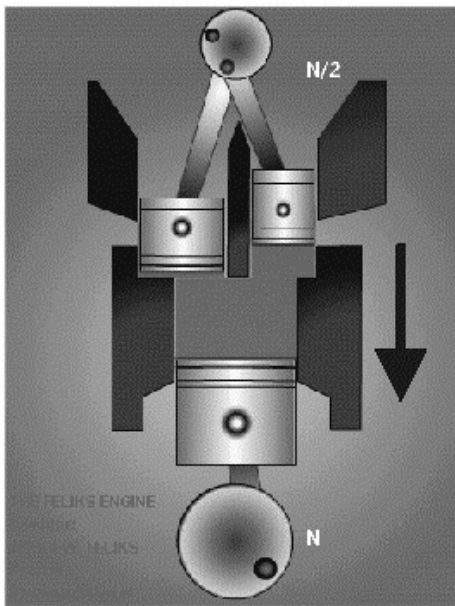
Author Andrew Feliks



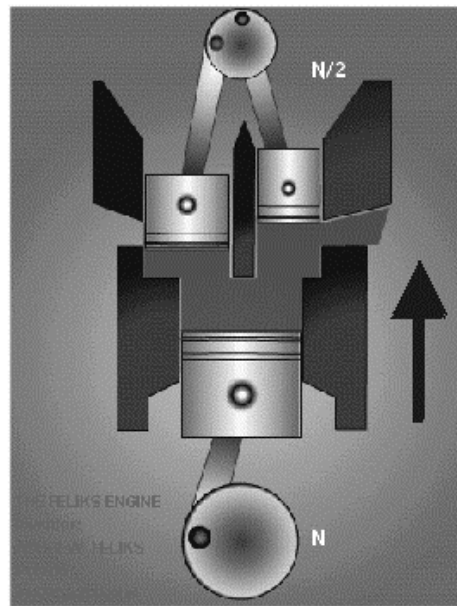
Intake stroke



Compression stroke



Power stroke



Exhaust stroke

Figure 1. 1

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As You can see, the construction is very simple and is an "ocean of new ideas", as one reviewer said. While working on it, I really came up with a same conclusion as I had to overcome many new and sometimes unexpected issues in order to make the work prototype. Choice of amount was one of basic problem „ crankshaft gear” two or one has turned out One of the fundamental issues is the choice - how many crankshafts do I use?

The first prototype, based on a 1 cylinder engine, had 2 of them, connected with a chain. I had many doubts about resonance problems before I made it. Surprisingly it worked very smoothly, without any flirt or vibrate. Match worked stably exclusively and quietly. I have observed it only that change of part of tension of indirect chain one part of chain was tense before firing of engine - pulling opposite side when started This chain have been transmitted after firing in active time on other part tense , showing that rotary moment proceeds from timing crankshaft **FOR** main crankshaft. I have concluded from observation of work of engine, that match quietly CAN have two "crankshaft timing"

There can be either one or two crankshafts ,but as I had been building the second prototype, I decided that one crankshaft would be a more elegant solution.

Here comes also a very fundamental issue - to choose an **angle between** arm-cranks. It's a timing crankshaft, and must have not necessarily that 90 degree So what should it be?

In this construction, revealing of many unexpected things starts from here. At least You ought to know what is the compression ratio in the designed engine.

It occurred to me, that the fundamental calculation of the intake volume and minimal chamber volume would be a difficulty and getting the compression ratio will be more complicated than I thought. This calculation depends on diameter of pistons, stroke, height of the intake and exhaust windows, and what is more on the angle between crankshafts. So we have many variables here, depending on each other - not so easy to calculate. At that time I didn't have the means necessary to easily calculate them, even grading precision by 10 deg would be a disaster to calculate without a computer.

So I did a special FORTRAN program, it was 1982 so it had to be on perforated cards - very time consuming too - and I received, although many constant assumptions, a big family of results. It has given family of result at many constant which me jumping capacities, minimal capacities, degree of compressing and we achieve maximum for that corner and minimum of above-mentioned value.

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After analyzing the results, I was surprised that the intake volume changes while the angle between the crankshafts changes (!!). This change, as the parameters and sizes of the diameters and strokes of all three pistons is constant, is little - but in a range of possible work of the engine - can reach few percent.

The minimal chamber volume can vary about to 400%, which was a huge surprise. This calculations revealed the possibility of the compression ratio change from 7 to 24 (!!). Minimal room is not 360 degrees of turns of main axes also, as we are acclimated for it. The minimal chamber volume is in radically other point of the crankshaft rotation - not traditionally in 360 deg, but in 375 deg, 15 deg after the T.D.C. (U.D.C.) where the torque of the (shoulder) arm-crank is much greater. This several degrees takes a stand after external expression of main crush which minimum surely big increase of rotary moment will cause that - maximum gas power acts on greatest shoulder of crank of axis.

I cannot exactly say, what it would incorporate in combustion process, because it is a very new, DYNAMIC and VARIABLE “combustion area.”

Family compression ratio calculations, based on my prototype, prototype introduce below.

Figure 2.

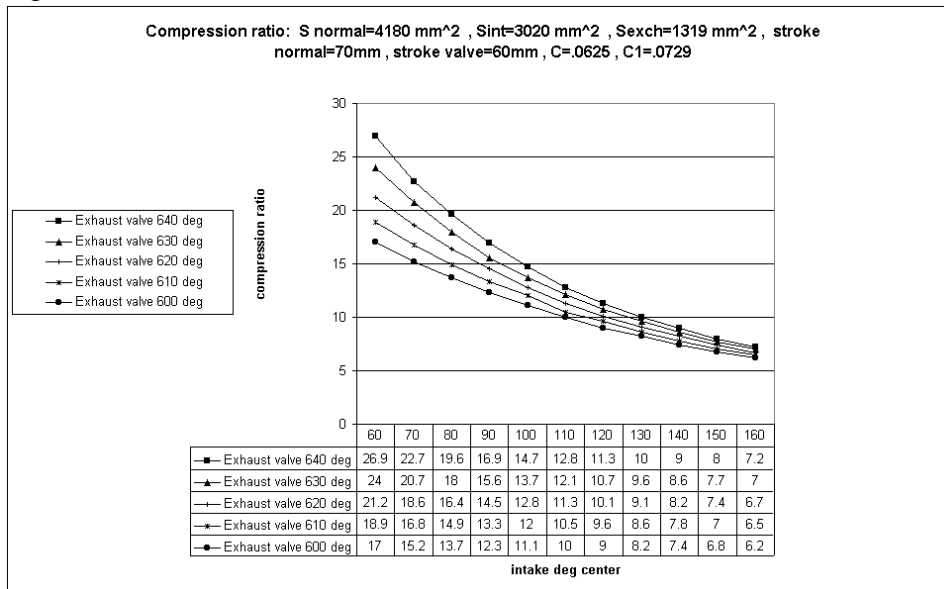


Figure 2. 1

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Minimal intake volume, depending on the angle of the main crankshaft, based on my prototype, prototype introduce below.

Figure 3.

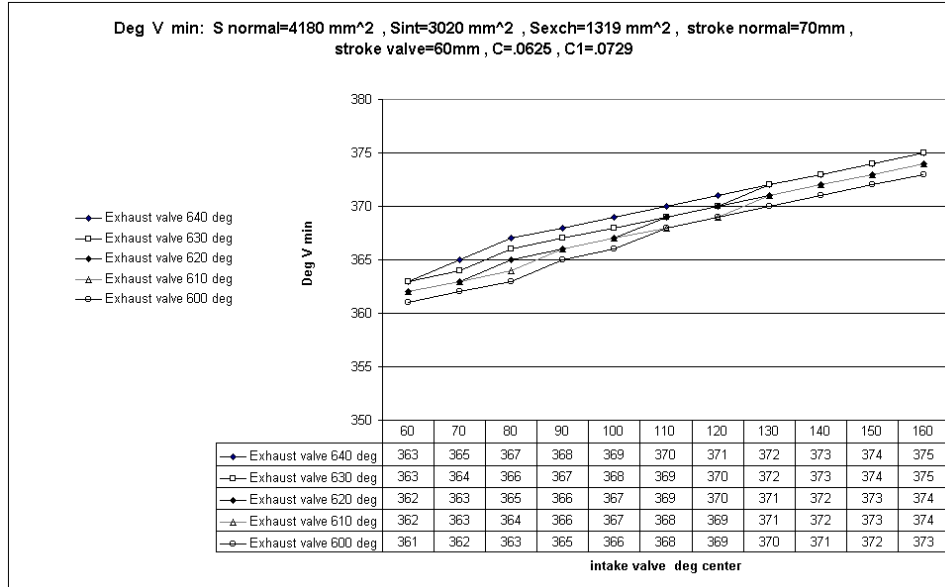


Figure 3. 1

Those diagrams present that we deal with a new, **VARIABLE combustion** area (If it could be named a "combustion space", because it's dynamic) The traditional combustion chamber had been developed through last 100 years, in this case, developing the combustion space will occupy due to computers less time definitely a bit.

Right now, a lot of advantages of this idea can be seen - variable compression ratio, while changing the angle between crankshafts for all own cylinders in the engine, by adjusting only **ONE** mechanism. The adjustment of the angle will rather increase the torque. The valve pistons also impact effect rotary moment also positively rather on the overall torque. Especially, the exhaust piston (It is smallest piston), which is affected by the maximum firing pressure on the maximum (shoulder) arm-crank.

Summing up all variable alternate coherent as:

- | | |
|---------------------------------------|---------------------|
| 1. Individual diameters of pistons, | 3 part x 4 dim = 12 |
| 2. strokes of particular pistons, | 3 part x 4 dim = 12 |
| 3. angles between crankshafts, | 4 x 4 x 4 = 64 |
| 4. height of the connecting rod, | 3 part x 2 dim = 6 |
| 5. deviations from pivot of cylinder, | 3 part x 2 dim = 6 |

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6. slips of integrity of crushes outside more or inside of main cylinder, 2 dim = 2
7. distances of pivots of axes crankshafts, 2 dim = 2
8. the height of the intake/exhaust windows. 2 part x 3 dim = 6

If we will increase it, then give we about 8.000.000 possible combination of dimension of geometric engine (!!!)

This shows the complicity of the basic design, so there's a great difficulty to choose the right geometry and design with the first engines, whether the technology is rather simple and doesn't seem to be an issue here. The biggest challenge is for the designers, not for the technological engineers.

To cover the topic, starting from the combustion process, toxicity of the exhaust gases and fuel consumption will surely be time consuming, but I think it is worth the effort, because the overall physical efficiency of this engine is better - due to its geometrical advantages (50% increase of volume capacity). To understand it better - take my prototype - it intakes a similar amount of air, as it was a 3 cylinder engine, but it has only 2 cylinder.

There are no reflexive masses of the theoretical third cylinder, and power of inertia of the timing gear is smaller, because it's turning with a half of speed of the main piston (that gives as four times smaller inertia forces). Overall physical efficiency is surely better up to few percent.

I wonder how a indicator diagram would look like, considering this bigger and unstable volume capacity.

I estimate that the fuel consumption would be affected with:

- bigger volume capacity - better efficiency (- 20%)
- variable compression ratio (- 10 %)
- lack of the valve springs - less power needed to operate them the timing gear (- 10 % in full power-in no full power largest)
- possible changes of intake and exhaust angles (- 10 %)
- mechanically forced combustion process (- 5%)

It gives a really unbelievable improvement, but after good testing, it might be real. Even if the output would be a few percent, it is still worth the effort.

The improvement in load exchange is worth mentioning too. There are much less aerodynamic defiance here, especially in the intake process - that also affect the fuel consumption. It's possible to improve the combustion process with making a special shape of the dynamic

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combustion area, arranging the flow, similar to diesel engines with a precombustion chamber injection, but without energy loss at choking passage, so that diesel could operate at much higher rpm.

The geometrical and thermodynamically issues are not so obvious, while considering such old construction. One of the most important advantages is that there are NO elements working percussively. The well lubricated, pistons are working silently and smoothly. Any crankshaft or timing gear failure does not cause any additional failure to the engine. This is a big improvement in reliability. In addition to this there is almost no limitation of rpm, while considering the timing gear. There is no valve's clearance and no service it, no such a thing in here. The endurance of the set of main pistons is the only thing that limits the rpm. The power can be too received from the timing gear, which is important, for e.g., for aircraft engines - where the rpm should be rather low, because of the propeller. In other construction this "low rpm" power will advantageous e.g. in agrimotor.

The design of the engine could be very simple, because it can be made of only one block, eliminating the overhead, and complications that come with it.(gasket, e.g.) The dynamic and combustion forces are relatively different to a popped valve engine. It's worth to mention that the minimal volume capacity is about 15 deg after after the T.D.C the main piston turn, what affects surely the torque, because the arm-crank is much greater then. The arm crank of the exhaust piston is 70-120 deg after the T.D.C , while the greatest combustion forces take place - it may cause a strange effect - the maximum torque can be taken from the smallest piston (!!). The concept of receiving power from the timing gear can be really interesting and improving.

While we consider the possible combinations of all of these elements, we could even reach one billion combinations.(!!) The first thing to do I guess is to create a software that could calculate all of these elements, using rather a really powerful computer, to simulate the engine behavior and make the first design easier. Perhaps this invention, because of it's unique features, will be a start of a new internal combustion science division.

Fundamental question in this engine are very low temperature in combustion area

When right cooling, is no greater 400 grad Celsius.(!!)This low temperature will influence trouble made NOx.

I mentioned the most fundamental aspects of this invention, which seem to me to be the most basic for those who would go deeper into it and would like to follow this idea and perhaps try to design first of

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those engines. What I said here is a product of 25 years of developing, thinking, predicting and struggling with it.

I add a little Excel 2000 program to the article, which can help with a basic 3 cylinder engine design (similar to my prototype). This might be a primitive program, but it helps to illustrate the most fundamental geometrical dependencies, which can be helpful in designing a basic model of this engine. Good luck!

Andrew Feliks