DESIGN AND ANALYIS OF MICRO AIR CONSUMPTION ENGINE

[1]Santosh Thore, [1]Akash Yadav, [1]Ashwini Kedari, [1]Sneha Nighot, [*1]Vikaskumar Mehtre

[1]Undergraduate Scholar,[*1]Assistant Professor
[*1]Mechanical Engineering Department
Anantrao Pawar College of Engineering and Research, Pune, India

Abstract : This paper includes Design, Static analysis result of main components of previously reviewed paper under title "MICRO AIR CONSUMPTION VEHICLE WITH ENERGY MULTIPLIER ".the experimental setup shown in the previous published paper contains main components like main,steppedshaft,pinion shaft and pinion gear .Assemble altogether in CATIA software.

Further we go for generation of meshing of components and stress analysis under static load .also obtained total deformation results all performed in ANSYS software.

Index Terms - *Main Shaft, Pinionshaft, Pinion Gear Etc.*

I. INTRODUCTION

We have been raised with the idea that it is necessary to burn a fuel to produce power which we can use. We are sold coal, coke, timber, paraffin/kerosene, petrol/gasoline, diesel, propane, etc. for us to burn in order to "get" energy. While it is perfectly true that burning these things will indeed result in energy in a form which we find convenient to use in heating, cooling, powering engines, etc. what is carefully avoided is the fact that it is not at all necessary to burn a fuel in order to run the things which we want to power. This 'inconvenient' fact has been concealed and denied for more than fifty years now (very surprisingly, by the people who want to sell us these fuels to burn – do you perhaps think that they may have some motive for this, other than our best interests which they no doubt are very concerned about?).

This chapter is about 'fuel-less' motors. Strictly speaking, they are not 'self-powered' but as they don't burn a fuel of any kind, in everyday language they can be described as 'self-powered'. In the same way that a solar panel in sunlight uses no fuel and yet puts out electrical power, these motors draw energy from the environment and provide us with mechanical power. In actual fact, power is never "used up" but just converted from one form into another. In the case of our trusty solar panel some 17% of the radiation from the sun (mainly ultraviolet) is converted into electrical power and 83% goes in heating and other losses, but as we don't have to supply the sunlight, and the solar panel pours out the electricity which we want without us having to do anything to make it happen, we really don't care very much about its extremely low efficiency. As far as we are concerned, the electricity flowing from the panel is "free-energy".

The Air engine is a engine currently being developed and, eventually, manufactured by Moteur Development International (MDI), founded by the French inventor Guy Nègre. It will be sold by this company too, as well as by ZevCat, a US company, based in California.

The air engine is powered by an air motor, specifically tailored for the engine. The used air motor is being manufactured by CQFD Air solution, a company closely linked to MDI.

The motor is powered by compressed air, stored in a engine bon-fiber tank at 4500 psi. The motor has injection similar to normal motors, but uses special crankshafts and pistons, which remain at top dead center for about 70% of the motor's cycle; this allows more power to be developed in the motor.

Though some consider the engine to be pollution-free, it must be taken into account that the tanks are recharged using electric (or gasoline) compressors, resulting in some pollution, if the electricity used to operate the compressors comes from polluting power plants (such as gas-, or coal-power plants). Solar power could possibly be used to power the compressors at fuel station.

The engines MDI will produce are not being sold (May 2006), and have been said to be coming into production "soon" since at least 1998. It was, for example, announced to make its public debut in South Africa in 2002, or "within six months" in January 2004. Since there thus seems to be a delay, potential buyers can also buy their engines from ZevCat (for the time being).

Besides MDI, there is also another company that delivers fully assembled engines running on compressed air (+electric), it is called Energine Corporation and their engines are more precisely named pneumatic-pneumatic electric vehicles (PHEV)s.

The application of pneumatic actuators has been extending widely in many fields since 1960s, because of cleanness, low-cost, little maintenance, etc. However, when the world neared the end of the 20th century, energy efficiencies of all kinds of driving systems were discussed and compared at the background of facing the problem of energy and environment in the world. As a result, it was reported that the energy efficiency of pneumatic systems is very poor compared with. electrical systems and hydraulic systems, and it is even lower than 20%.

Today, most of users are making efforts in cutting down the air consumption in their plants such as avoiding air leakages, adjusting operating pattern of devices and so on. At the same time, pneumatic equipments manufacturers are accelerating the development of products that can save energy. However, with regard to the research of pneumatic technology, there is not any clear method to calculate the available energy of compressed air, and it is not clarified how much energy are lost in supply pipes or at actuators.

Because of air compressibility, heat transfer, etc., it is difficult to establish a method to have an energy assessment for pneumatic systems. Among pneumatic equipments, it is considered that actuator and air compressor result in the low energy transformation efficiency of pneumatic systems.

Although there are many projects with the purpose to discuss the characteristics of cylinders, the study of energy on cylinders is little. As the main actuator of pneumatic systems, large quantities of cylinders are used in automatic production lines. It is an important project to establish an energy assessment method for pneumatic systems and to clarify the energy consumption of air cylinders.

In this project, firstly, the concept "energy" is introduced to assess the available energy of compressed air instead of enthalpy. Its calculation and characteristics are also introduced. Then, the distribution of supplied energy at one actuation cycle of cylinder is discussed based on simulation with proved mathematic model of cylinder actuation. Lastly, in order to compare the energy distribution pattern between meter-out and meter-in circuit, horizontally and vertically actuating cylinder with those two circuits are also investigated potentially lower initial cost than battery electric vehicles when mass produced.

The most recent development uses pressurized air as fuel in an motor invented by Guy Nègre, a Frenchmotorer. A similar concept is currently being developed by the UruguayanmotorerArmando Regusci and an Australian Angelo Di Pietro. Despite interest in the technology, no company has yet put a vehicle using this technology into mass production. A successful vehicle would offer many of the advantages of a battery air operated engine with the additional ability to quickly restore the stored energy - in a few minutes rather than the hours required to recharge batteries.

Air motors are powered by compressed air. They operate at relatively high speeds in industrial and spark-prohibited applications. They can be regulated easily for speed and torque, and can stop and reverse very quickly. They are commonly used in many industrial applications and are noted for their economic power delivery, straightforward maintenance and safety in spark-prohibited applications.

The most important performance specifications to consider when searching for air motors include required torque, maximum air pressure, air consumption, rated free speed (output), and operating noise level. Torque is the turning force delivered by a motor or gear motor shaft, usually expressed in lbs. ft derived by completing H.P. x 5250/RPM = full load torque. The maximum air pressure is usually specified in pounds per square inch. Minimum, maximum, or both can specify the air consumption of the motor. The rated free speed is the speed with no load at rated pressure. Note that this is the speed of the output shaft for a gear motor. The operating noise level is the noise level in decibels (dB) produced by the motor.

Compressed air as an energy source:

It offers an advantage over electric as there are no batteries to manufacture or disengined—which is an important environmental factor. Most modern batteries can be recycled, reducing this advantage.

As with electric, it must be stressed that compressed air is only an energy vector therefore can only be as clean as its source. Compressed air technology is not as technically appealing as electric or gas/electric pneumatic but it is cheap, accessible to all and available now. For infrastructure, grocery store parking spaces could be fitted with a pressure hose, eliminating the need for refueling stations, although quite who would pay for the energy used, and the infrastructure required, is not clear. The energy could be obtained through wind turbines, or mechanically from a stream without having to through electric. This would obviously have an impact on the surrounding environment; few grocery stores have a stream, or a wind turbine, at the moment.

The compressed air motor as a power plant for other vehicles

As seen on the website, the air motor not only powers engines (private/taxies) but possibly also buses. Boats and, rather less likely, airplanes (if they're using normal propellers and not turbofans), could be powered with this motor as well.

For fans of vehicles powered by alternative energy and electricity, the air motor is good news as well, since they can use it to power their own transferred-emissions vehicle.

They can simply buy an air motor from CQFD and connect it to a engine chassis (which can be obtained for approximately the same price as a new engine).

At first glance the idea of running an engine on air seems to be too good to be true. Actually, if we can make use of air as an aid for running an engine it is a fantastic idea. As we all know, air is all around us, it never runs out, it is non-polluting and it is free.

An Air Driven Engine makes use of Compressed Air Technology for its operation. Compressed Air Technology is now widely preferred for research by different industries for developing different drives for different purposes. The Compressed Air. Technology is quite simple. If we compress normal air into a cylinder the air would hold some energy within it. This energy can be utilized for useful purposes. When this compressed air expands, the energy is released to do work.

So this energy in compressed air can also be utilized to displace a piston. This is the basic working principle of the Air Driven Engine. It uses the expansion of compressed air to drive the pistons of the engine. So an Air Driven Engine is basically a pneumatic actuator that creates useful work by expanding compressed air. This work provided by the air is utilized to supply power to the crankshaft of the engine.

In the case of an Air Driven Engine, there is no combustion taking place within the engine. So it is non-polluting and less dangerous. It requires lighter metal only since it does not have to withstand elevated temperatures.

As there is no combustion taking place, there is no need for mixing fuel and air. Here compressed air is the fuel and it is directly fed into the piston cylinder arrangement. It simply expands inside the cylinder and does useful work on the piston. This work done on the piston provides sufficient power to the crankshaft.

MAIN SHAFT:

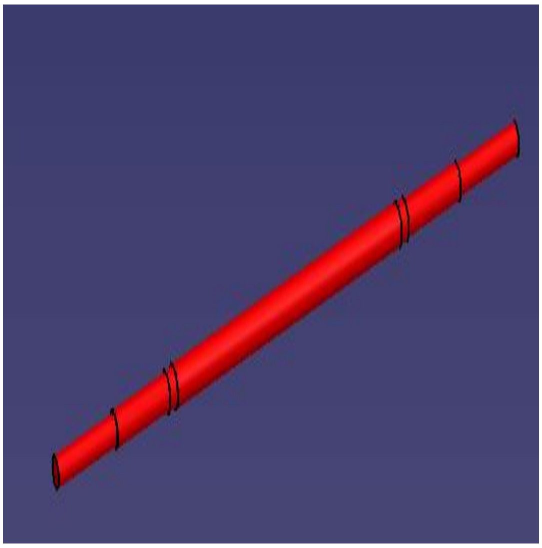


Fig. 1 Main shaft

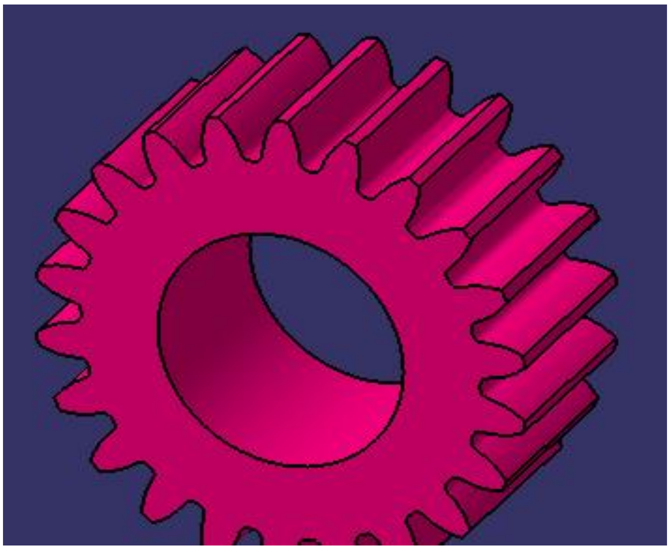


Fig. 2 Pinion

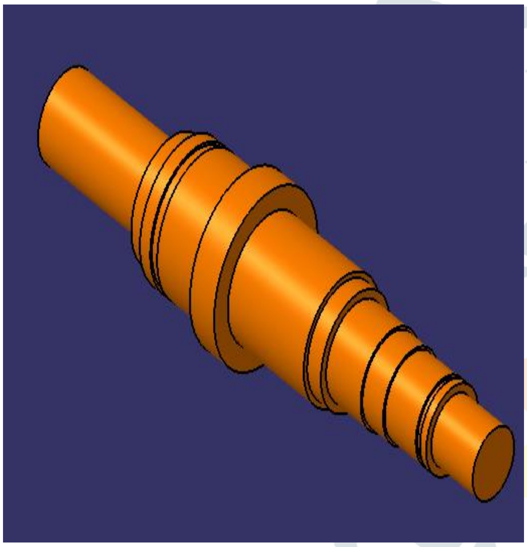


Fig 3. Gear shaft

Table 1: Input data

Design ation	*Tensile Strength N/mm2*	*Yield Strength N/mm2*
EN9	*600*	*380*

1. RACK : 1module , 60 teeth , Pinion : 1 module , 15 teeth.

Load = 70 N

Material of pinion and gear is High steel

Tensile strength =800 N/mm2

S_{ut} pinion =S_{ut} rack = 800N/mm2

Service factor (Cs) = 1.5

dp = 15

II. CALCULATIONS

1. PINION GEAR

Now; T =Pt x dp/2

⇒Pt = 10 N. -------- (A)

A) Lewis Strength equation

WT = Sbym

Where;

Y= 0.484 – 2.86

Z

⇒yp = 0.484 -2.86/15= 0.294

⇒Syp = 235.2

WT = (Syp) x b x m

=235.2 x 10m x m

WT= 2352m2---------- (B)

Equation (A) & (B)

2352.m2 = 10

⇒m=0.068 ….APPROX…. 0.1

Selecting standard module =1 mm

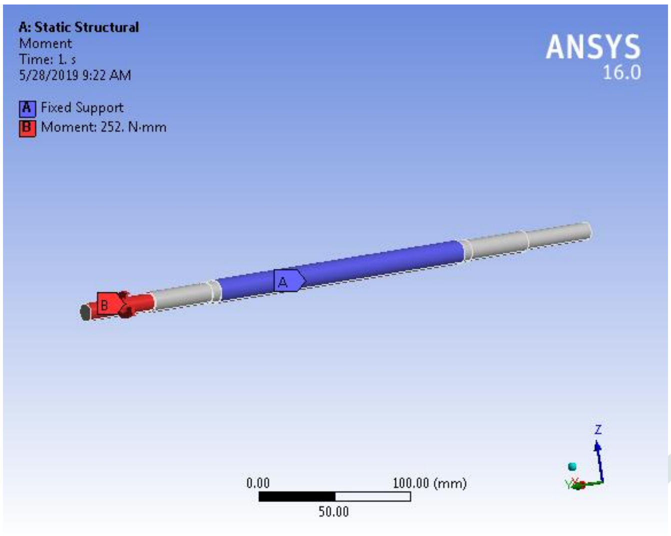
GEAR DATA

No. of teeth on pinion=15

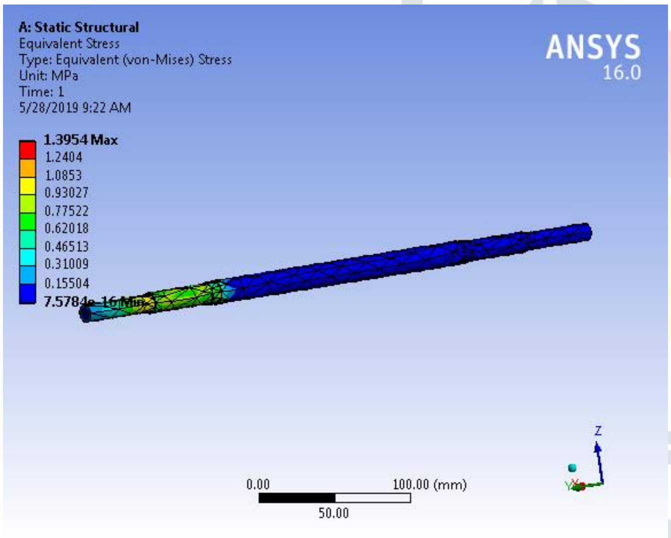
No. of teeth on rack=60

Module = 1mm

III. NUMERICAL ANALYSIS

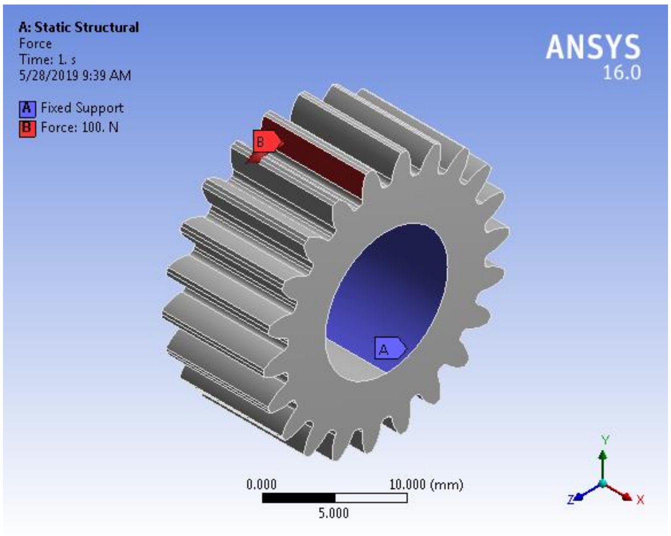


By fixing the shaft at point A and applying momentum at point B ,we get the safe value of momentum for main shaft about 252 N-mm.

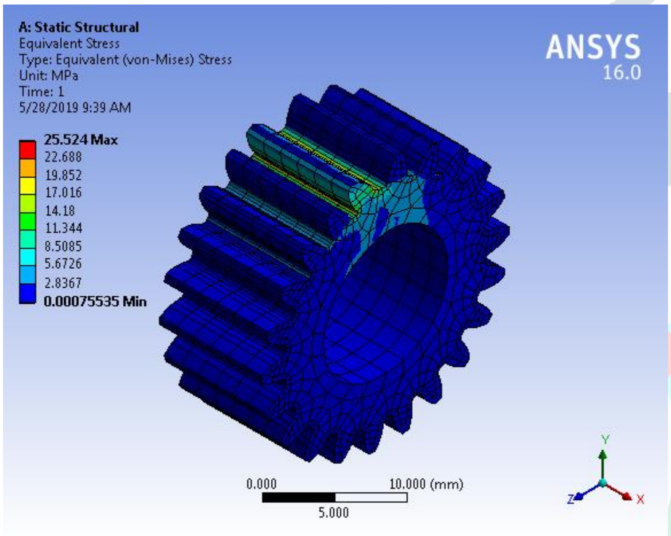


From above analysis, we get the maximum value of equivalent stress about 1.3954 N/mm2.

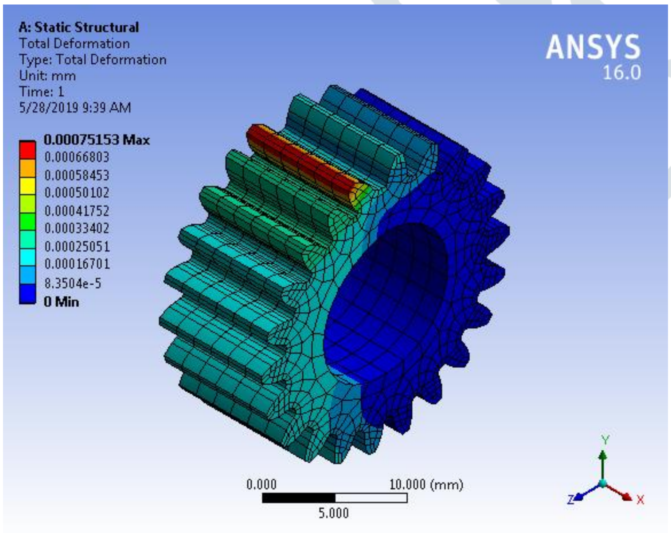
IV. ANALYSIS OF PINION



Maximum force about 100 N is applied to pinion.



Equivalent stress (by Von Mises) is varied between 0.00075535 to 25.524.MPa.



Hence the total deformation is 0.00075153 mm.

V. CONCLUSION

As we studied stress analysis of main components of micro air consumption engine.

We found the maximum stress limits which are as follows

For main shaft=1.3954 MPa.

For pinion shaft=$0.47851*10^{-5}$MPa.

For pinion gear=25.524MPa

.

REFERENCES

[1] Design and Dynamic Analysis of Single Stroke Compressed Air Engine
By Abhishek Lal.
Published under: INTERNATIONAL JOURNAL OF
RENEWABLE ENERGY RESEARCH Abhishek Lal,
Vol.3, No.2.(Year : 2013)

[2] AIR POWERED ENGINE by Prof. B. S. Patel, Mr. R S Barot,
Karan shah, Pushpendra Sharma.
Published under: National Conference on Recent Trends in Engineering
& Technology. (Year: 2011)

[3] AN ADAPTIVE ROBUST CONTROLLER FOR TIME DELAY MAGLEV TRANSPORTATION SYSTEMS
Reza Hamidi Milani , Hassan Zarabadipour , Reza Shahnazi (Year 2011)