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On Flow of Energy and Application of Principles to Engines.

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Abstract- This paper aims at an attempt to define physical phenomena in terms of energy and the flow of energy within an isolated system. This paper also establishes some basic principles regarding the limiting of energy flow and the changing of state due to the transfer and circulation of energy. Furthermore It has been attempted hereby to appropriately apply the constructed principles to the working of modern day engines in order to increase the efficiency of such engines.

Index Terms- Cerenkov radiation, Desaturation, Energons, Energon exchange, Phase transformation, Photoelectric effect, Saturation, Saturation and desaturation of mass energy.

1.0 Introduction

In any system, energy is seen to flow only until one of the parts of the system is saturated with energy content or the other is desaturated. For example, if a simple pendulum is left to oscillate in a damping environment, it loses energy to the surroundings, possibly, heating the surroundings at a low scale, maybe because of the continuous heat loss from the surrounding layers of air around the pendulum to the following layers one after the other. But if the pendulum or a similar object that loses energy continuously, is left to oscillate in a confined atmosphere with a limited amount of air (or any gas), it might lose energy and heat up the gas, but only until a point of saturation of energy in the gas. More generally, it can be stated that energy flows between parts of a system only until the receiver of energy is saturated with energy content, which probably depends upon the nature of material of the receiving object.

The project is majorly concentrated upon the behaviour of energy and its flow in a system, its dependence upon the constituent materials of the system and the changes encountered when any one of the parameters change, leading to a statement which must be able to explain the flow of energy within an isolated system. Most of the work in this project is based upon calculations according to laws of energy transfer and such mechanisms.

For the experiments, we were largely dependent upon the mechanics and the study of waves, because, waves are remarkable phenomena accounting for every aspect of energy flow during their propagation. A similar help was obtained from the thermodynamic systems, as their major workings are dependent upon the flow of energy. Choosing the Carnot cycle, I confirmed maximum efficiency, hence clearer details. The analysis of wave propagation shows that the flow of energy largely depends upon the type of medium the wave front encounters during its motion through a medium, e.g.: waves reflect upon encountering a rarer or a denser medium, also transmitting some energy, to the new medium resulting in a new wave front along the encountered medium. In this process, the interface, absorbs some energy till some time, and then becomes passive to anymore of energy. I called this situation, energy saturation in the particles at the interface.

A similar behaviour was shown in the Carnot cycle, theoretically as well as experimentally. As the temperature of the source is increased, the engine's and the other elements' temperatures increased resulting in a greater output and better and better efficiency. But after sometime, the temperatures of the source and the sink and the output were all constants until the engine was turned down. 0 %< efficiency<100%; which theoretically proves that the engine's output must stop somewhere nearby 100, and maintain constancy. The engine in this case was a piston cylinder with normal air, the source was a heater with controllable temperature level and the sink was the surrounding acetone bath, whose constancy and changes in temperature were determined by observation of the change in the rate of its evaporation. (Rate of evaporation ~ T)

Further, in a situation of phase transformation, it can be said that the object transforms state in order to extend its energy saturation limit, if continuous energy is being supplied to it, and will reach a point after may be, multiple transformations, a phase, where it cannot contain any more of energy and therefore, will liberate its excess energy regaining former phases, and finally the state of maximum stability and minimum energy.

Behaviours of objects, while undergoing phase transformations, i.e.: fusion, melting, conversion of phase's shows that they resist gaining anymore energy (concept of latent heats). But after transformation they continue to gain energy, hence proving the observations mentioned above right.

2 EXPERIMENTAL VIEWPOINT AND PROOFS-

2.1 Experiment - Analysis of Cerenkov radiation (highly suggested experiment though, very inaccurately performed here, due to lack of resources)

Independent variables- accelerating potential (V).

Dependent variables-Frequency of emitted radiation (f) and hence, colour of the radiation (if visible) and magnitude of the photo-current.

2.2 Method-

2.2.1. Fill a glass tube with dielectric fluid in it. Using metal plates on either side of the dielectric material, apply a potential difference in order to accelerate the electrons beyond the phase velocity (or until you see visible radiation). Surround the glass-dielectric system with an array of photo-voltaic cells attached together and an ammeter, continuously measuring the current against time.

2.2.2. In a dark environment, release electrons (probably with an electron gun) in the dielectric, and accelerate them beyond the phase velocity, applying necessary potential difference across the tube.

2.2.3. Release electrons multiple times applying different potential differentials, (hence different energies) every time, until constancy in photo current is observed.

2.2.4. The changes in the photocurrent and radiation colour (hence frequency) were measured and plotted it against time.

2.3 The Cerenkov Experiment was done at a very small scale using a television tube (cathode ray tube) filled with N_2 as dielectric, in the tube and about 20 solar photo-voltaic cells arranged around it. Hence, inaccuracy is expected unlike experiments 1 and 2 but the experiment proves enough to be believed rather that opined. The experiment is supported by the theoretical view that the rad. frequency and the photocurrent has to limit its "increasingness" somewhere, because, the electron cannot attain the ultimate speed.

3 RESULTS AND OBSERVATIONS

3.1 Mathematical logic-

According to the photo electric theory, $I_{photocurrent} \sim K_{max} = hf - \varphi$, where, f = frequency of incident photons, φ= work function of the metal and K= kinetic energy, henceforth. During Cerenkov Effect in the swing, the Energy of the charged particle appears as radiation from the dielectric medium, hence by the law of conservation of energy, it can be said that $K_{charged\ particle} \sim f$ (frequency of radiation). Hence, $(K_{charged\ particle}.\ k) = f$.

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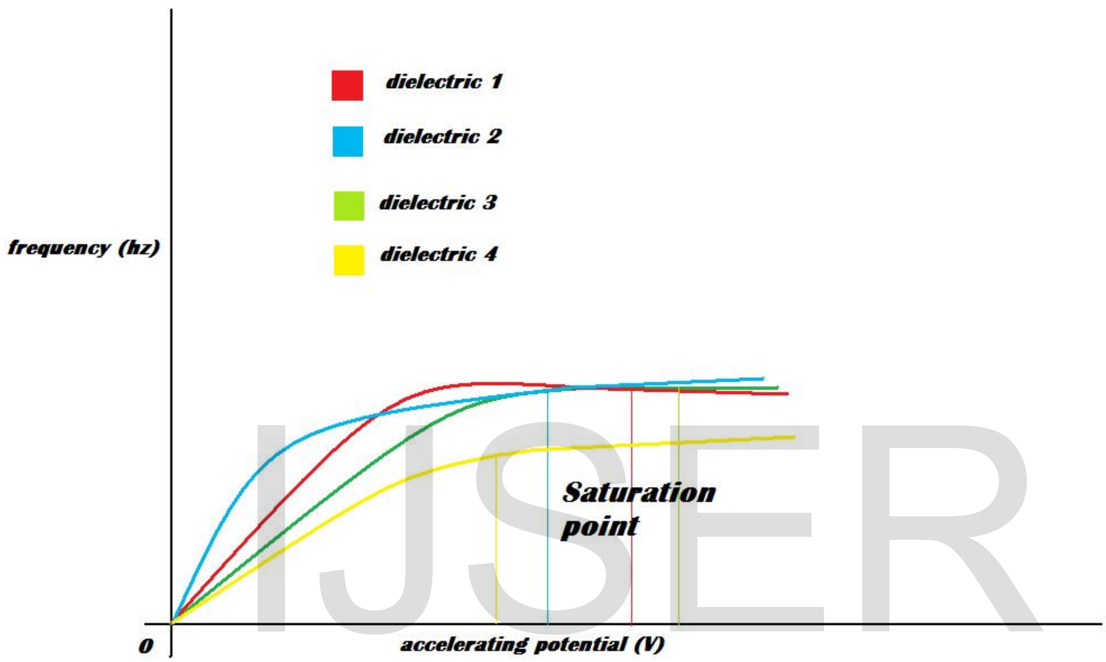
$\Rightarrow I_{photocurrent} \sim K_{max} = h\,(K_{charged\ particle}.\ k) + \varphi$. Since, φ is a constant, $I_{photocurrent} \sim K_{max} \sim K_{charged\ particle}$.

In this case as well, the photocurrent becomes (approximately, because of the inaccuracy of experiment) constant, indicating saturation of energy content in the medium of transmission, or somewhere in the system. Had the dielectric or the photo voltaic cells been changed, the current would have had attained a greater or a smaller energy saturation point, varying with the material of the elements of the system. (Experimental observations accurate to around 80% of calculated values)



1. Dependence of saturation point on introduced dielectrics

4. CONCLUSIONS

Based On the performed experiments and obtained data and the following section mathematical observations, the following laws were formulated.

4.1 **Theorem 1.** *Energy between any two elements of a system continues to flow only till the source is desaturated or the sink is saturated with energy (mass-energy), and the flow drops exponentially with time. In the likely case of either of the one occurring, the energy will be bypassed by the sink, remaining unaffected. The law and the ones further stated accounts for ALL sorts of energy including those due to inertial forces and the mass-energy equivalence.*
This law defends Carnot's fact that 0 %< efficiency of a physical system<100%.

4.2 **Theorem 2**. *Law of continued saturation- If in an isolated system, Energy is continuously transformed from one form to another without any dissipation or loss, and the final form of energy marks saturation of energy content, all the forms of energy, each, at some moment of time, were sure to be at a saturation level in the system, and for a any particular form of energy existing at any moment, has the same level of saturation.*

If the energy is transformed through n forms, and if E_{sat}^{n} *is finite, then,*
$E_{sat}^{1}, E_{sat}^{2}, \dots\dots\dots\dots, E_{sat}^{n-1}$ *Must be finite. Also,* $E_{sat}^{1} = E_{sat}^{2} = E_{sat}^{3} = \cdots\dots\dots\dots\dots = E_{sat}^{n}$.

4.3 **Theorem 3.** *Law of Capacity of Energy- A particle's or substances' saturation level of energy is directly proportional to the size or the volume content of the object. A more volumetric substance has a higher energy saturation level.*
(The law serves as a proof for the phenomena of phase transformation to more volumetric phases as energy is continuously transferred)

$$E_{sat} \propto V_{sink}$$

4.4 **Theorem 4.** *Law of energons exchange- Two or multiple particles or elements of the system involved in the process of energy exchange, carry out the exchange of energy by particle (or fluid) (hypothetical) or quantum exchange in discrete amounts and not in a continuous manner. The rate of exchange of particles (or fluid) marks the saturation of either the sink or the desaturation of the source.*
This is when the rate of exchange of these particles is equalled both ways.

$$R_{fwd} = R_{bwd}$$

Where, R_{fwd} *is the rate of transfer of particles from the source to the sink and* R_{bwd} *is the rate of transfer of particles from the sink to the source. These particles have for the moment been coined energons which is a set of all particles which mediate energy in any form.*

4.5 **Theorem 5.** *Energy is supplied until the return of energons starts between the particles illustrated in the diagram.*

Intensity of energons exchange is directly proportional to the level of unsaturation of the sink.

$$E_{sat} \propto \frac{\oint_S E^0 . dS}{ds.dt}$$

And, by Gauss' theorem, $\oint_S E^0 . dA = (\nabla . E^0) . dV$

Where, E^0 *is the Intensity of Energon Exchange.*

4.6 **Theorem 6.** *The moment or point of saturation or desaturation of energy in the system can be thought of as a point of equilibrium.*

4.7 **Assumption.** The *particles are assumed to adhere to properties of Bosons and to co-ordinates specified by* R^3*, and travel at the speed of light , "c" and are assumed to be massless, until further results.*

5. APPLICATIONS

5.1 TRANSFORMATION OF ENGINES

We suggest transformation of engines and their components of automobiles in such a manner that increases their efficiency.

5.1.1 By lowering the amount of energy wasted.

Let's suppose the engine supplies a constant amount of energy E_{sup} and the average saturation level of the engine, counting the contribution from each of the components be E_{sat} .
Therefore, unutilized, "wasted" energy = **β (E_{sup} - E_{sat}) ; β < 1** signifies non perfect emission of wasted energy.

Hence, efficiency = 1 – {β (E_{sup} - E_{sat})/ E_{sup} }

But, E_{sat} **~ 1/ϱ ;** ϱ is density of the material.

Hence, efficiency of systems can be increased by using components made of materials of low density, and high temperature tolerance.

5.1.2 By utilizing the wasted energy to generate power and increase output.

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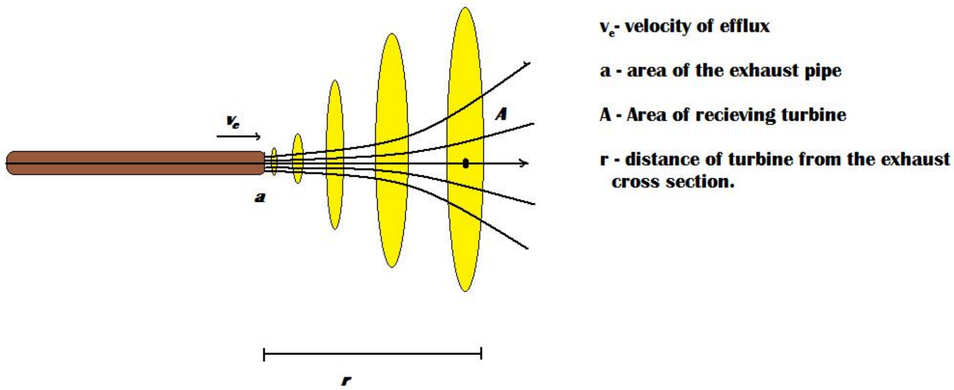
If the whole wasted energy is assumed to be in the exhaust, then energy of the exhaust is **E = β (E_{sup} - E_{sat} - E_{sat}^{air}) ;** $\boldsymbol{E_{sat}^{air}}$ ***is the sat. energy of the exhaust mixture.***

Let's say the exhaust has an area of "a" . And the turbine has an area A and is placed at a distance "r".



Hence, **E = β (E_{sup} - E_{sat} - E_{sat}^{air})**
Hence,
Intensity (I) = β/4πr^2 (E_{sup} – lt. Δt -> 0 [E_{sat}+ E_{sat}^{air}] / Δt)
Now,
Δt = Δr/v
By eqn of continuity,
v(r) = av_e

Hence, Δt= 4πΔr^3/ av_e
As **Δt -> 0, Δr -> 0**

Therefore,

I = β/4πr^2 (E_{sup} – av_e/3 {lt. Δr -> 0 E_{sat}/ [4πΔr^3/3]})

But, 4πΔr^3/3 is the volume of air emitted as a function of covered r.
Now, let's observe the given amount of exhaust volume as a function of r.
As Δr -> 0, ΔV -> 0,

I= β/4πr^2 [E_{sup} – av_e/3 {lt. ΔV-> 0 [E_{sat}+E_{sat}^{air}] / (ΔV)}]

Where V is the volume of the emitted air-fuel exhaust column.

Hence, power by the exhaust to the turbine area of cross section "A" is –
P = β/4πr^2 [E_{sup} – av_e/3 {lt. ΔV-> 0 ([E_{sat}+ E_{sat}^{air}] / ΔV)}] A
P = β/4πr^2 [E_{sup} – av_e/3 (∂E_{sat}/ ∂V) - av_e/3 (∂E_{sat}^{air} / ∂ V)] A
(∂E_{sat}/ ∂V) = 0 , since E_{sat} is a constant.

And assuming "α" to be a non perfect output factor for the turbine,

Power output by the turbine = P = $\alpha\ \beta/4\pi r^2\ [E_{sup} - \{(\partial E_{sat}^{air} / \partial\ V)\ a v_e 3\}]\ A$

Thus efficiency has been successfully increased!

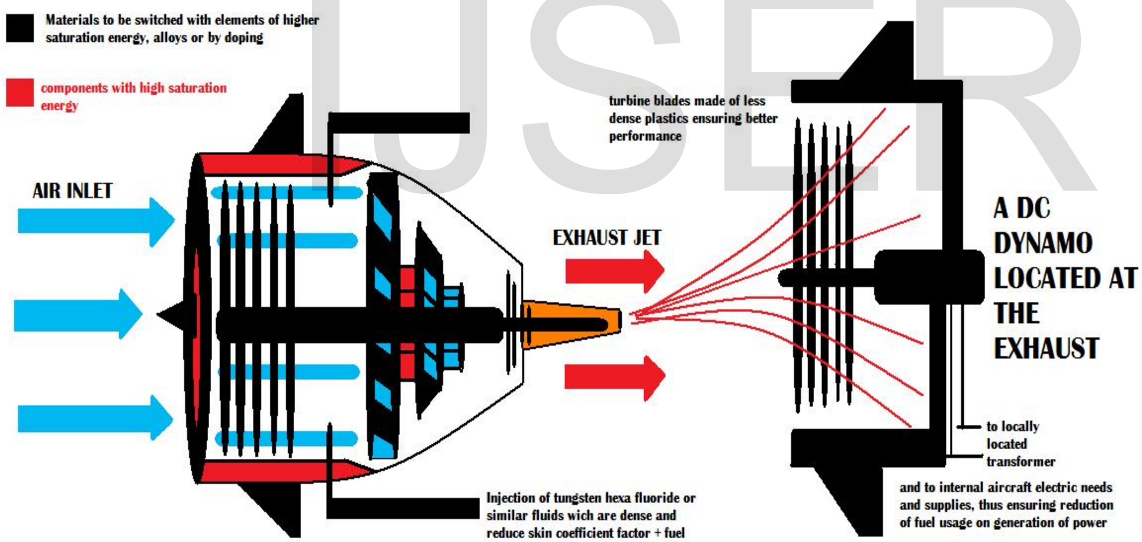
6. CONCLUSION

Energy between any two elements of a system continues to flow only till the source is desaturated or the sink is saturated with energy, and the flow drops exponentially with time. In the likely case of either of the one occurring, the energy will be bypassed by the sink, remaining unaffected. The law accounts for ALL sorts of energy including those due to inertial forces and the mass energy equivalence.
This law defends Carnot's fact that 0 %< efficiency of a physical system<100%.

The components of engines can be transformed to increase efficiency in the following ways.

6.1 By using less dense materials in the engine components, the saturation level can be increased thus wasting lesser energy.

6.2 By fixing power generating systems such as wind or gas driven turbines to generate electricity, thus, contributing positively towards increasing the efficiency.



Application of established principles to a Turbofan Engine

7 Acknowledgments

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7.2 Mr. Shyam Iyengar.

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