KINETIC ENERGY AND OVER UNITY

Jovan Marjanovic
B.Sc. in Electrical Engineering
e-mail: jmarjanovic@hotmail.com

Veljko Milkovic
Inventor and Academician SAIN
e-mail: veljkomilkovic@gmail.com

Veljko Milkovic Research & Development Center
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ABSTRACT

The goal of this work is to point out some important facts in formulas for kinetic energy and momentum (quantity of the movement) for moving bodies. It will be shown that over unity behavior is inherent in movement itself.

In this work the authors will discuss:

- origin of the formulas for linear momentum and kinetic energy,
- principle of adding energy to a moving body as the key for over unity,
- initial velocity in gravitation field,
- the best way of adding energy to the pendulum,
- validity of relativity of classic mechanics inside an inertial frame.

Key words: velocity, kinetic energy, momentum, over-unity, pendulum.

INTRODUCTION

This work has been written in order to clarify attitude of Mr. Veljko Milkovic who always believed that once a pendulum in his two stage mechanical oscillator started to swing it was easy to keep it operating by adding small energy to it [1]. This adding small energy to a moving object looked to most people as nothing important for energy balance of the machine. However, Mr. Milkovic continued his research and was looking for answers on many places, from simple tapping the basketball against the floor to gravity assist or slingshot for space ships [2]. He also read the story about origin of the current formula for kinetic energy [3] and asked his associate Mr. Jovan Marjanovic to study it and check its logic with an open view. The results are presented in this work.

KINETIC ENERGY AND MOMENTUM

In school books about mechanics nobody can avoid names of Sir Isaac Newton and Gottfried Leibnitz. It is well known in the history that sir Isaac Newton was concern more with forces and Leibnitz more with energy in their theories about mechanics. It is usually said that two scientists come independently to the same results. That was possible because they both developed new mathematical tools, known as derivation and calculus, necessary to solve differential equation without which present science can not be imagined. However, it is less known that two scientist had different views about energy.

For Newton, object's energy was simply the product of its mass times its velocity, or *mv*. If a five-kilogram ball is going 10 m/s, it has 50 units of energy. He accepted that view from René Descartes who called the product of mass and velocity ‘quantity of the movement’. Newton also deemed that if two forces of equal intensity and opposite direction collide, their energy would vanish into nothingness. That meant that energy in universe kept diminishing and that God himself had occasionally to intervene and wind the clock of the universe in order to keep it operating.

Leibnitz had different view and for him energy of a body was equal to the product of its mass times its velocity squared, or mv^2. He called kinetic energy ‘living force’. He also deemed that energy can not be destroyed and that if two equal forces were collided their energy would turn into heat, sound etc.

Scientists in England mostly supported views of Sir Isaac Newton and in Germany the view of Leibnitz. In France Voltaire popularized views of Newton too. In Holland, mathematician and philosopher Willem Gravesande performed an experiment with brass balls where he dropped them with varying velocity onto a soft clay surface. His results were that a ball with twice the velocity of another would leave an indentation four times as deep, that three times the velocity yielded nine times the depth, and so on [4]. He shared these results with Émilie du

Châtelet, who subsequently corrected Newton's formula $E = mv$ to $E = mv^2$. She also turned her lover Voltaire on her side and Leibnitz's view prevailed in France. Latter, factor ½ was added in formula as more correct. It was the consequence of the usage of calculus. In mathematics it is known that integral of a function x equals to $\frac{1}{2} x^2$.

Current formula for kinetic energy of a moving body with mass *m* and velocity *v* is given down:

$$E = \frac{1}{2} m v^2 \qquad (1)$$

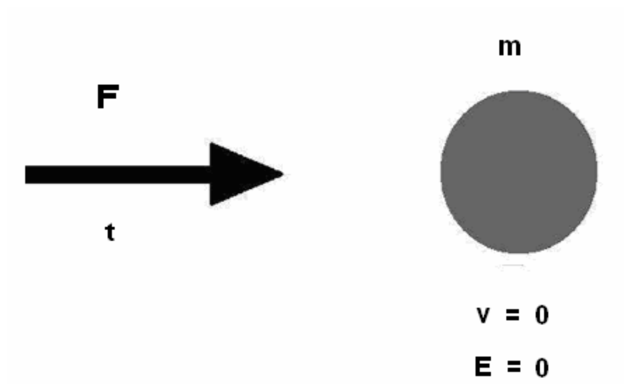
However, over the course of time it has been accepted that for passing energy from one body to another it is important to know the quantity of the movement or momentum of the body. Knowing kinetic energy of the body was more important if energy has to be transformed in another state like potential energy, electric energy or heat.

So, another basic formula in each book about mechanics is a formula for momentum of the body *K*.

$$K = m v \qquad (2)$$

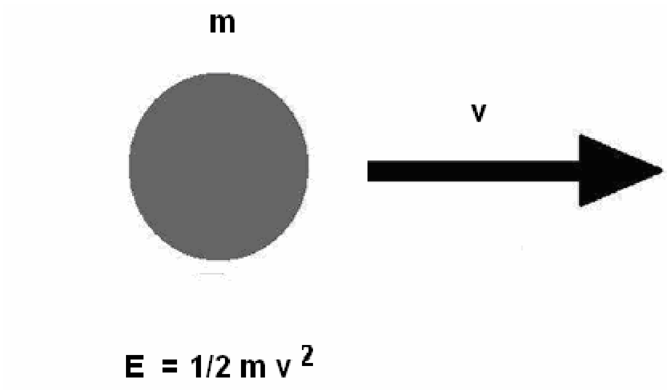
KINETIC ENERGY INCREASE

Here will be analyzed the case of energy passing from a force to a body. The force could also have a body, but it will be disregarded as well as impact of the law of the conservation of momentum to both bodies. It will also be supposed that force is fast enough to catch the body and pass some energy to it even if the receiving body had some velocity. Practically, the force must be an Impulse which always passes the same path regardless if the ball was in rest or movement. It could be set of electromagnets which always push the ball from the same distance. Bellow on *picture 1* is the force passing energy to a ball in rest.



Picture 1

The force *F* was acting for time *t* against the ball. The ball received acceleration *a* and for time *t* got velocity *v* equal to *a* x *t*. Then force stopped pushing the ball forward. The new state is below on *picture 2*.



Picture 2

The ball is moving with constant velocity *v* and has kinetic energy *E* received from the force *F*. This means that force *F* performed work equal to energy passed to the ball and then stopped passing the energy to the ball. Let's suppose that the ball had mass equal to 2 kg and had received velocity of 1m/s. It would mean that the ball got kinetic energy ½ x 2 x 1^2 equal to 1 Joule. The same energy force *F* lost on its side.

Let's suppose that force *F* acted again against the ball pushing it for the same period of the time and with the same intensity. Because Newton's laws are equally valid for the body in the rest or the body with constant and straightforward movement, it is logical to assume that force *F* passed the same kinetic energy of 1 Joule to the ball and increased the velocity of the ball for 1m/s again. This means that force *F* passed totally energy of 2 Joules to the ball and caused it to move with constant speed of 2m/s.

Because the ball got velocity of 2 m/s its kinetic energy is ½ x 2 x 2^2 and equals to 4 Joules. So, the final result is that force *F* passed 2J, but the ball got 4J. This is a clear case of over unity behavior of the ball receiving energy in portions. Note also that if the force *F* passed the same energy of 2J in one double longer push, the ball would have received the same energy the force spent for the push.

PULSING FORCE AND OVER UNITY

In previous paragraph it has been shown that passing energy in portions was the key to energy increase. Here general rule will be explained.

Regardless of how many portions of passing energy existed, for the ball and the force only two states existed: Old state where the ball had constant velocity v_{old} and Force state where the force *F* caused velocity increase v_{new}. So, after Force state the ball got total velocity:

$$v = v_{old} + v_{new} \tag{3}$$

In Old state the ball had kinetic energy $E_{old} = ½ m v_{old}^2$ and in Force state it received from the force kinetic energy $E_{new} = ½ m v_{new}^2$. The sum of kinetic energies of two states is

$$E_{old} + E_{new} = ½ m (v_{old}^2 + v_{new}^2) \tag{4}$$

Let's now calculate kinetic energy *E* of the ball after Force state. By changing (3) into (1) it is obvious that

$$E = ½ m (v_{old} + v_{new})^2 = ½ m (v_{old}^2 + 2 v_{old} v_{new} + v_{new}^2) \tag{5}$$

Energy increase or Over-unity energy E_{over} can be found as the difference of the kinetic energy after Force state (5) and kinetic energies of two states (4):

$$E_{over} = E - (E_{old} + E_{new}) \tag{6}$$

By changing (5) and (4) into (6) it appears that energy increase is

$$E_{over} = m v_{old} v_{new} \tag{7}$$

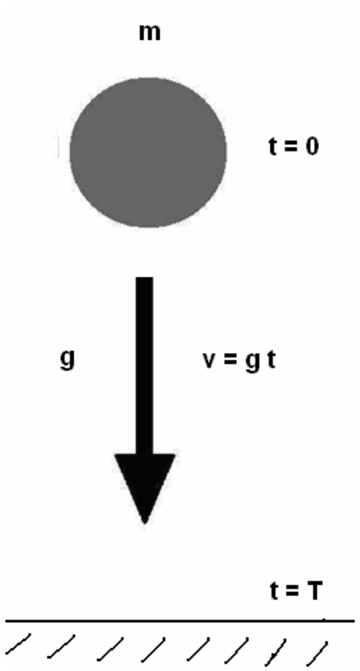
It is important to find when over unity energy (7) has its maximum. Instead of using high mathematics it will be demonstrated by using simple example. Let's suppose that the ball has velocity after Force state of 10m/s. If the ball had old velocity of 1m/s than Force state contributed 9 m/s. The product of these two velocities would be 9 $(m/s)^2$. The same result would be if old velocity was 9 m/s and Force state contributed 1 m/s. Let's now suppose that old velocity was 5 m/s and Force state also contributed 5 m/s. The product of last two velocities would be 25 $(m/s)^2$. This is much more than in previous two cases. This means that formula (7) will have its maximum if two velocities were the same. <u>So, the best result would be if the force *F* speeded up the ball for the same velocity the ball had initially.</u>

Note that if the ball never released some of its energy to a consumer its velocity would grow exponentially if the force *F* kept passing maximum energy to the ball. This means that the ball must pass some of its energy to a consumer, but not all. If the ball passed all of its energy to a consumer its velocity would become zero and next push by force *F* wouldn't give any over unity energy. So, the balance must exist between giving energy to the ball and taking it off by a consumer. That way force *F* could continuously give some of its energy and create over unity energy periodically, by pulsing. <u>So, the pulsing is really over unity way of passing energy to a ball as an amplifier of energy before releasing some of its energy to a real consumer.</u>

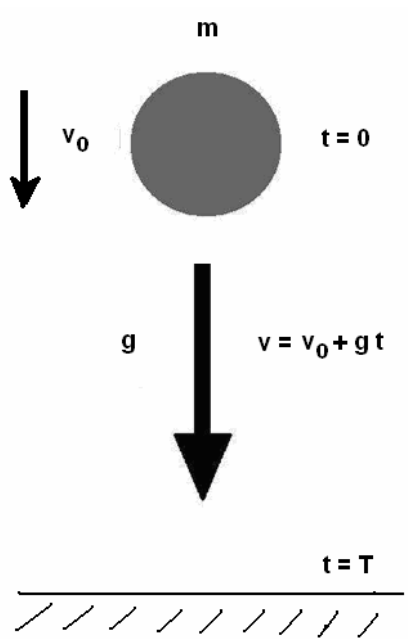
GRAVITATION AND OVER UNITY

The same logic as above can be applied in the gravitation field to create over unity behavior of a gravity machine.

Let's observe a free falling body in gravitation field without initial velocity as below on *picture 3*. Gravitation field will accelerate body constantly with intensity g which equals to 9.81 m/s^2.



Picture 3



Picture 4

In above example total velocity v after period of time T can be calculating as product of acceleration g and time T and would be equal to gT. Kinetic energy of the body after time T would be

$$E = ½\, m\, (gT)^2 \tag{8}$$

Next will be observed the same body in the same gravitational field, but with initial velocity v_0 caused by some force before the body was allowed to fall freely, see above *picture 4*.

Here, total velocity after period of time T will be

$$v = v_0 + gT \tag{9}$$

Kinetic energy after period of time T is

$$E = \frac{1}{2} m (v_0 + gT)^2 = \frac{1}{2} m (v_0^2 + 2\, v_0\, gT + (gT)^2)$$

$$= \frac{1}{2} m\, v_0^2 + m\, v_0\, gT + \frac{1}{2} m\, (gT)$$

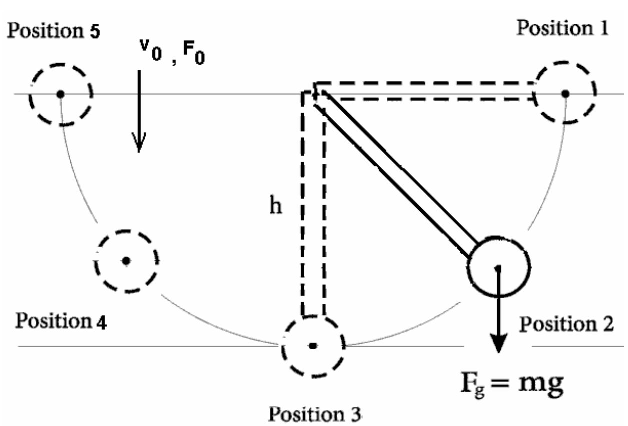
$$= E_{init} + E_{over} + E_{gravity} \qquad (10)$$

Kinetic energy formula consists of three members. The first member is $\frac{1}{2}\, m\, v_0^2$ and represents kinetic energy the body had initially before free fall in gravitational field. Third member $\frac{1}{2}\, m\, (gT)^2$ is kinetic energy body got from gravitation field. The second member $m\, v_0\, gT$ is over unity energy E_{over}. It is the same as formula (7). Again, it would be the best if initial velocity v_0 was equal to gT. If initial velocity was very big then gravitational contribution would not be so important and the opposite.

An example of over unity energy from *picture 4* is in sport when a member of a basketball team keeps tapping a ball against the floor. Energy passed in the floor as heat is always greater than energy invested by player hand. Note that gravitation energy should be disregarded because the ball would rebound and return back to the player hand.

Pendulum and Over Unity

One special case of gravity usage is the pendulum. Potential energy of the pendulum bob raised to height h is $m\, g\, h$. Potential energy would start converting to kinetic energy once the pendulum bob was allowed to fall freely. Conversion is finished when pendulum comes to low position 3 and velocity of the pendulum bob is also greatest in low position 3. When pendulum starts to raise up it will start to convert some of its kinetic energy to potential energy again. That process of energy conversion would be without the end if friction in pendulum axis and resistance of the air wouldn't exist. Because of the frictions the pendulum will start to lose some of its energy and become still after some time.



Picture 5

By pushing pendulum bob and giving to it some additional velocity an over-unity condition (explained in above paragraph) would be created. If the push happened in its highest position 1 or position 5 than additional velocity would be initial velocity v_0. However, it is possible to push the pendulum lower in position 2 or position 4, but over-unity would be smaller as the gravitation contribution is smaller in lower position and become zero in low position 3. So, it is the best to keep pushing the pendulum in its highest positions.

THE ORIGIN OF OVER UNITY ENERGY

The most important question is how actually over unity energy is created if it was possible at all. In order to answer that question it is necessary to overview definition of the energy spent by a force *F*. It is said that energy increase of the body pushed by force *F* is equal to the work performed by the same force along the path of the body. Practically, both the work and the energy are equal to the product of the force *F* and length of the path *l* the force passed, see down.

$$E = F\ l \tag{11}$$

Direction of the force must be the same as direction of the path the body passed. If their directions have an angle α then cosine of the angle must be included in the formula:

$$E = F\ l\ cosine\ (\alpha) \tag{12}$$

The path *l* can be calculated as product of velocity *v* and time *t:*

$$l = v\ t \tag{13}$$

Above three formulas could be used as such only if both, intensity of the force and its velocity were constant in the time. The presence of the force means that the body would receive acceleration; it also means that velocity is never constant in above formulas. That is the reason they can not be used directly. To find kinetic energy calculus must be used. The calculus represents the sum of very small values, so small that we can regard them to be constant for very small period of the time. By using calculus energy formula (1) was invented by Leibnitz.

According to Newton, if moving body had acceleration it means that a force was acting upon it. No acceleration means that there was no force pressing the body and it would move with constant velocity without changing its direction. Such a body would have a momentum and kinetic energy equal to energy spent by a force which initially caused the body to acquire its final velocity.

Nobody yet examined energy balance if a force acted on a body which had initial velocity v_0. Total velocity for such a body would be:

$$v = v_0 + at \tag{14}$$

where a is acceleration caused by the force and t is time the force was acted on the body. By changing (14) into (1) kinetic energy formula would become:

$$E = ½\, m\, (v_0 + at)^2 = ½\, m\, (v_0^2 + 2\, v_0\, at + (at)^2)$$

$$= ½\, m\, v_0^2 + m\, v_0\, at + ½\, m\, (at)^2 \tag{15}$$

Above formula is the same as formula (10) for over-unity in gravity field. The first member represents energy spent by old force which initially acted on a body and caused it to have initial velocity v_0. The third member is contribution of new force which further speeded up the body. <u>The second member is over-unity member and represents product of velocities caused by both forces. This member can be looked as acceleration of initial velocity v_0 or better to say acceleration of initial kinetic energy.</u>

Above statement could sound strange to some people, but according to Einstein, the energy and the mass are the same things in two states of existence. This means that moving body can not be looked isolated without its speed. It means that new force accelerated not only body, but its initial kinetic energy too.

The problem is that current formulas don’t take it into account. Theoretical reason could be the fact that if velocity of the body doesn’t change its intensity and also its direction, there is no any acting force upon it and nobody would further examined such a body. Practical reason could be the fact that it is not possible to measure directly acceleration of kinetic energy itself because it doesn’t have a mass. However, it could be detected indirectly as extra energy on the body side, presently named as over-unity energy.

CONCLUSION

Here new theory has been developed. The theory which says that acting impulse of a force against moving body will not only accelerate the mass of the body, but also its initial kinetic energy too. The product of initial velocity and additional velocity times the mass would be measurement of extra energy or over-unity energy.

As said above, this theory is founded upon the fact that laws of the mechanics are equally applicable on bodies which moves with constant speed and straight line direction (uniform motion) as on bodies in the state of the rest. This fact is known in mechanics as Relativity of Classic Mechanics and systems which move with constant velocity are called inertial frames. Connections between coordinates of two inertial frames are named Galilean transformations.

Basic dogma of classic mechanics is that there is no any mechanical experiment inside an inertial frame which could confirm whether that inertial frame is in the state of uniform motion or in the state of absolute rest [5].

Here presented theory says that such experiment does exist. If a mechanical system gave more energy out than what was invested in, that system is in the state of the movement because it had initial velocity. Practically, an over unity system can not be in the state of absolute rest.

The question can be aroused what about rotation. It is well known in mechanics that kinetic energy of rotating body has similar form as formula (1). It has momentum of inertia *I* instead of the mass and angular speed *ω* instead of the velocity:

$$E = \frac{1}{2} I \omega^2 \qquad (16)$$

Above formula would give the same results as formula (1), if a force could increase angular speed second time for the same intensity it did the first time.

Because any movement around the circle has acceleration directed towards the center named Centripetal force, Newton's laws can not be directly applied the second time the same way as before body started to move. However, if the center of the mass wouldn't move then Centripetal force wouldn't do any work and logic for linear movement could work for rotation also. If the body was symmetric then Centripetal force is always balanced even if the center of the mass was moving. The problem with orbit of space module Explorer I proved that rotating bodies in gravitation field have extra energy [6].

Another question could be asked: What is the best way to use a force to push a body fast enough and not to follow it for long path because long path means doing additional work by the force. One excellent way was already explained on page 7. It is the pendulum. The pendulum comes to stop on each side, but it doesn't loose its kinetic energy because the pendulum converts it into potential energy. Because the pendulum stops movement in its highest positions the force doesn't need to chase it and additionally loose some of its energy. By initial pushing of the pendulum bob with external force it can collect over unity energy by using gravity force. It can also easy pass some of its energy to a consumer by installing a gear on its axis.

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Jovan Marjanovic
B.Sc. In Electrical Engineering

Jovan Marjanović

Veljko Milkovic
inventor & academician SAIN