# THE SECRET OF FREE ENERGY FROM THE PENDULUM

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

Veljko Milkovic Research & Development Center – VEMIRC
May 05, 2011, Novi Sad, Serbia

## ABSTRACT

The goal of this work is to demonstrate the importance of length of a pendulum with movable pivot point on its energetic efficiency and power. Maximal possible over unity quotient will be determined under some conditions. Influence of critical angle (angle when pivot point start to move) on energy of the pendulum will also be shown.

*Key words: pendulum, pivot point, over unity, energy, centrifugal force.*

## INTRODUCTION

The author's previous work (second issue) [1] has shown the influence of the law of conservation of angular momentum on the velocity of a pendulum and the centrifugal force if the length of the pendulum handle was changed in the lowest position of the pendulum. The conclusion was that the law of conservation of energy was valid, regardless if the pendulum handle was shortened or extended and that the pendulum, as a parametric oscillator can not give an energy surplus.

It was well known to us, from the practice, that the two-stage mechanical oscillator of Veljko Milkovic [2] would behave badly if the pivot point was allowed to perform great movements. This was the reason to use logic of shortening the motion of the pivot point and increase the pendulum force with a bigger mass of its bob, in order to keep desired output power of the machine constant.

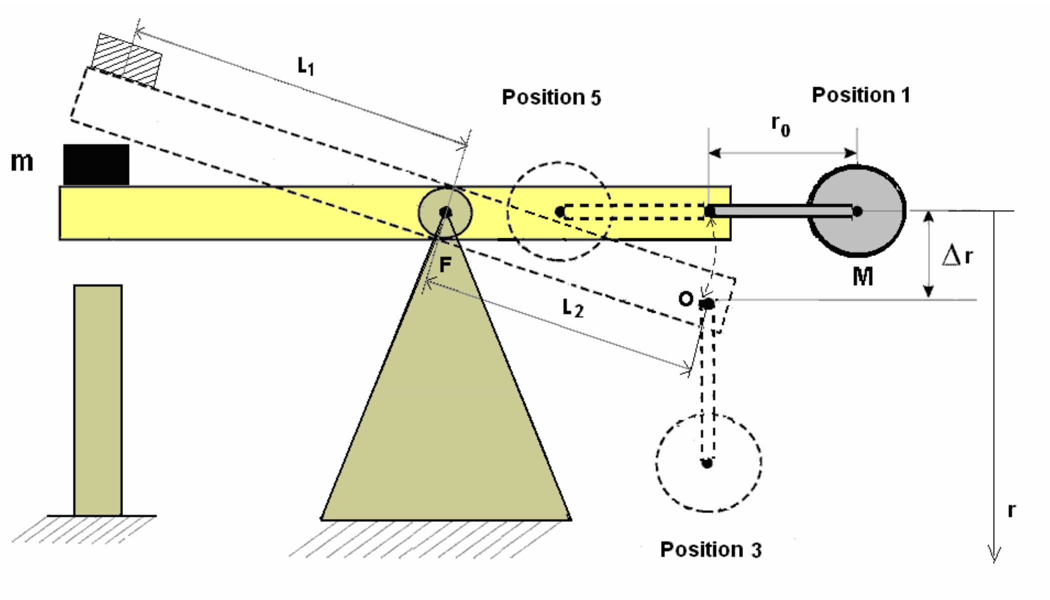
The author came to this conclusion in his work by an accident. It happened on a tractor when he was thinking about mechanical analogies of over unity methods for electromagnetic machines. He wanted to devote one chapter to them in a book he started to write.

This work is the author's most positive work, concerning the existence of over unity energy of a pendulum with a movable pivot point, but only under some conditions.

## OUTPUT WORK OF TWO-STAGE MECHANICAL OSCILLATOR

It is important to clear up which force is doing output work in the two stage mechanical oscillator, in order to determine general over unity conditions.

The oscillator, in picture below, has proven to be very complex for exact mathematical analysis. The returning influence of mass *m*, on the left side of the lever, contributes to the complexity. The unused energy of mass *m* would oscillate if the oscillator worked as a hammer, unless there was attached an energy consumer, like a water pump, to left side of the lever.




*Picture 1*

The main function of mass *m* is to return pivot point *O* to its starting position when the pendulum becomes weightless in the end positions. That work of mass *m* is minimal and will be disregarded in further analysis. Second function of mass *m* is to reset an energy consumer in its starting position, if it was, for example, a water pump with piston. In the case of double winged water pumps, there are no starting positions because it works in both directions. In both cases, mass *m* performs useful work, but only with the help of accumulated potential energy which it received from the pendulum. The same would be the case, if instead of mass *m,* a spring was installed on the left side of the lever.

<u>The conclusion is that the output energy of the oscillator depends only on a pendulum with a movable pivot point and only the pendulum will be further analyzed</u>.

We will observe only the vertical movement of pivot point *O* of the pendulum because only it performs useful work, and it is also much greater than horizontal movements.

**Work of Pendulum with Movable Pivot Point**

It is known that initial energy invested in raising pendulum in starting position 1 is equal to its potential energy:

$$Ep = M\ g\ r_0 \qquad (1)$$

where height $r_0$ is equal to length of pendulum handle if starting position of pendulum had angle of 90 degrees from vertical line, as on above picture.

It is also known that the pivot point of the pendulum will descend for some length $\Delta r$, as in above picture. That descent will diminish potential energy of the system for amount

$$\Delta Ep = M\ g\ \Delta r \qquad (2)$$

This energy decrement must be compensated for, in order that the pendulum can rise again in the starting position 1 or 5. It means that it is a normal loss in the system for pendulum maintenance, if oscillator spent all output energy and nothing was returned back as oscillation.

Friction losses and air resistance were disregarded, as we know that they are small.

It is also known that tension force in lowest point (position 3) is equal to

$$T = 3\ M\ g \qquad (3)$$

under the condition that the pendulum was allowed to fall down from the initial position of 90 degrees from a vertical line. Part of the tension force is centrifugal force and is equal to

$$Fc = 2\ M\ g \qquad (4)$$

If the pendulum's initial position had an angle of 60 degrees, then total tension force would be *2Mg* and centrifugal force would be equal to weight force *Mg*.

Weight force *Mg,* can't perform over unity work on the output side because energy of the weight is oscillating in the pendulum. If the weight were to perform work then swinging of the pendulum would stop. For the same reason, potential energy loss (2) must be compensated.

<u>This means that only centrifugal force can perform over unity work and the role of gravitation is only to create centrifugal force</u>.

Work of centrifugal force for initial angle of 90 degrees equals to

$$Ec = 2\ Mg\ \Delta r \tag{5}$$

and in case of pendulum with initial angle of 60 degrees it equals to

$$Ec = Mg\ \Delta r \tag{6}$$

It was assumed here that centrifugal force committed work when pendulum was in area around lowest point, because there centrifugal force is strongest and has direction of vertical line as pendulum handle.

It should be noted that pendulum velocity in position 1 and position 5 is equal to zero and there is no centrifugal force there. Because the pendulum is in a weightless state in those positions, there is no tension force *T* there. That means that the pendulum doesn't perform any work if  the pivot point was moved up in those positions. The work wouldn't exist even if tension force *T* would exist there because it would be normal to movement of the pivot point.

In calculation of quotient of efficiency of the oscillator, work of weight *Mg* must be included too (which must be compensated), i.e. to divide total output work with input energy which is periodically added to the system in order to maintain swinging of the pendulum. Initial potential energy *Ep* invested to raise the pendulum in starting position can not be taken into the calculation because it will be returned back when the oscillator stops working.

Total output work of movable pivot point *O* in position 3, for pendulum with initial position 1 of 90 degrees equals to:

$$E_{out} = T\ \Delta r = 3Mg\ \Delta r \tag{7}$$

Total output work for pendulum with initial angle of 60 degrees equals to:

$$E_{out} = 2Mg\ \Delta r \tag{8}$$

Because it is necessary to add input energy to the pendulum, given by formula (2), and output energy is given by formula (7) or (8), it means that maximal quotient of efficiency of the machine, for initial angle of 90 degrees is equal to **3,** and for pendulum with initial angle of 60 degrees it equals to **2**. This would be valid only if there were no change of magnitude of centrifugal force when pivot point started to move.

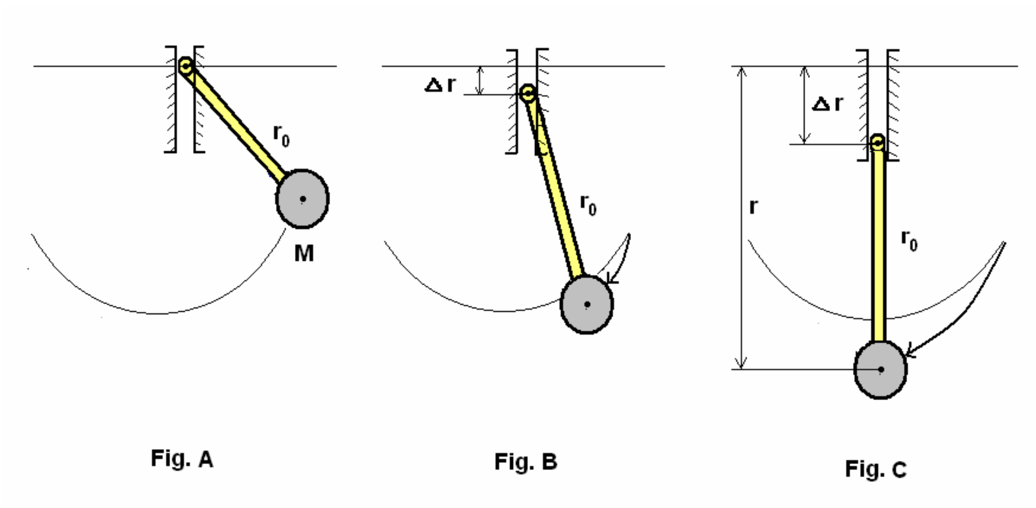
If a pendulum could made full circle and initial position were up, against lowest position 3, then total tension force *T* at lowest position would be *5Mg*, and maximal quotient of efficiency would be equal to 5.

## INFLUENCE OF MOVEMENT OF PIVOT POINT ON CENTRIFUGAL FORCE

The important thing to perceive is the fact that centrifugal force is decreasing when the pivot point moves downwards. Formula for centrifugal force is given down:

$$Fc = M\,v^2 / r \tag{9}$$

When the pivot point moves downwards, the path of pendulum bob is not circular any more and has tendency towards flattening, i.e. the circle is straightening. It is the same as if the radius of curvature $r_0$ would be extended for $\Delta r$, see picture below.




*Picture 2*

A new formula for centrifugal force in low position 3 is:

$$Fc = M\,v^2 / (r_0 + \Delta r) \tag{10}$$

The decrease of the pendulum velocity also contributes to the decrement of centrifugal force.

From author's previous work [1] it is known that extension of the pendulum handle in low position 3 will decrease velocity of the pendulum because of validity of the law of conservation of angular momentum. That law is valid only around low position 3 because moment of the force *Mg* for pivot point *O* doesn't exists there or is very small.

Velocity in position 3 is changing according to the law of conservation of angular momentum and is given by formula:

$$v = \frac{r_0}{r_0 + \Delta r} v_0 \tag{11}$$

where $v_0$ is pendulum velocity in low position 3 for a pendulum with fixed pivot point, or for the pendulum with movable pivot point before change of radius of curvature for pendulum bob. For details, see author's previous work [1].

By changing formula (11) into (10) we get formula for centrifugal force in low position 3 in which is included influence of motion of the pivot point in that position.

$$F_c = M \frac{v_0^2 \, r_0^2}{(r_0 + \Delta r)^3} \tag{12}$$

Centrifugal force is doing over unity work because of movement of the pivot point and it is equal to product of centrifugal force $F_c$ and path passed by the force $\Delta r$. In order to increase that work it is necessary to increase either centrifugal force or movement of the pivot point. The problem is that movement of pivot point is diminishing centrifugal force because of extension of radius of curvature $r$ and also because of decrement of velocity $v$. It means that extension of path of pivot point $\Delta r$ should be avoided and centrifugal force increased instead.

We have discovered the above logic by experiments and we kept output work constant by increasing the mass of the pendulum $M$ and by decreasing the path of the pivot point to a minimum by cutting the length of right side of the lever, *L2*.

## INFLUENCE OF LENGTH OF PENDULUM ON OSCILLATOR EFFICIENCY

A fact which wasn't obvious to us and which was pointed out by Mr. Raymond Head, construction businessman from Texas, is that extension of the pendulum handle would increase the output power of the oscillator [3]. Although his math was superficial, just to illustrate the fact, his observation was correct because of following reasons.

<u>If length of pendulum handle $r_0$ was long then once fixed movement of pivot point $\Delta r$ is proportionally small in comparison with length of the handle. It means that the movement of the pivot point will have a small influence on decrease of centrifugal force, due to the increase of radius of curvature $r$ and decrement of velocity $v$</u>.

It can be proven the following way. First we will find the formula for maximal velocity $v_0$ for a pendulum with a fixed pivot point and initial angle of 90 degrees. It is easy to find because in low position 3 all potential energy of the pendulum $E_p$ is transformed in kinetic energy $E_k$ and we have:

$$Mg\, r_0 = ½\, M v_0^2 \tag{13}$$

and from there we have that:

$$v_0^2 = 2\, g\, r_0 \qquad (14)$$

By changing (14) into (12) we have final formula for centrifugal force:

$$F_c = 2M\, g \frac{r_0^3}{(r_0 + \Delta r)^3} \qquad (15)$$

Over unity energy created by the work of centrifugal force is equal to:

$$E_c = 2M\, g \frac{r_0^{\ 3}}{(r_0 + \Delta r)^3} \Delta r \qquad (16)$$

Now we will make a table with fixed $\Delta r$ of 10cm, which is quite a great movement of the pivot point for a two-stage mechanical oscillator, but necessary for some consumers. Note that the movement of the lever on consumer side will also depend on proportion *L1: L2*. We will calculate a member from formula (16) for various values of length of pendulum handle $r_0$. The member is:

$$\rho = \frac{r_0^{\ 3}}{(r_0 + \Delta r)^3} \qquad (17)$$

| | | | | | |
|---|---|---|---|---|---|
| $r_0$ | 0.25m | 0,5m | 1m | 2m | 3m |
| $\rho$ | 0,364 | 0,578 | 0,751 | 0,864 | 0,906 |

From the above table it is obvious that there is an improvement of parameter $\rho$ for a greater length of pendulum handle $r_0$. The more parameter $\rho$ is close to 1, the less negative influence of the law of conservation of angular momentum on centrifugal force. Because centrifugal force has its maximum in low position 3, the importance of improvement of parameter $\rho$ is great.

## Initial Power of the Pendulum

By increasing the length of pendulum handle initial power of the pendulum will also be increased. However, it doesn't have influence on maximal output power of the oscillator which is determined by formula (7), because tension force *T* doesn't depend on length of the handle $r_0$.

If we look back on formula (1) we can see that initial energy of the pendulum *Ep,* is proportional to the height of starting position 1, and the height is the same as length of the handle if initial angle of the pendulum was 90 degrees.

Power is defined as time rate of energy:

$$P = Ep / T \tag{18}$$

Time $T$ is half period of oscillation of the pendulum and for small oscillations it is:

$$T = \pi \sqrt{\frac{r_0}{g}} \tag{19}$$

By changing formula (1) and (19) into (18), the power is equal to:

$$P = (Mg / \pi) \sqrt{g\, r_0} \tag{20}$$

It means that power will be increased with an increase of length of the handle, although period of oscillation will also be increased. The reason is the fact that the period of oscillation $T$ will not be increased proportionally with increase of the length of the handle, but with the square root of the length.

However, initial power of the pendulum can be directly transferred on output side of the oscillator only if it was increased by increase of mass $M$, because pendulum mass $M$ alone can increase tension force, i.e. weight and centrifugal force. Increase of length of the pendulum will indirectly increase output power of the oscillator by minimization of negative influences on centrifugal force.

## INFLUENCE OF CRITICAL ANGLE ON VELOCITY OF THE PENDULUM

Critical angle is the angle from a vertical line where tension force $T$, in the pendulum handle, is increased enough to be able to overcome weight of mass $m$ and resistance of energy consumer and pull pivot point downwards. That angle depends on, proportion of masses $M$ and $m$, consumer resistance, initial position 1 which determines maximal centrifugal force $Fc$, and also of proportion of length of left arm $L_1$ and right arm $L_2$ of the lever.

The Importance of critical angle is double fold because it affects not only centrifugal force but also the velocity of the pendulum. Velocity of the pendulum determines its kinetic energy which is actually transformed potential energy. We will first examine influence of critical angle on centrifugal force.

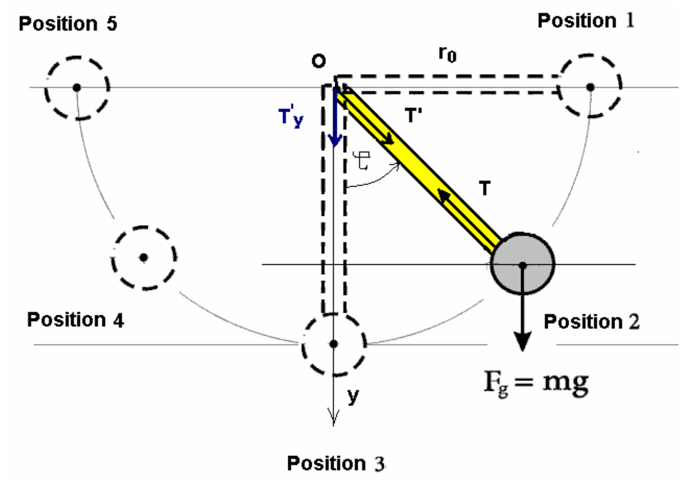
### Centrifugal Force and Critical Angle

Formula for tension force in pendulum handle with fixed pivot point is:

$$T = Mg\,(3\cos(\varphi) - 2\cos(\varphi_0)) \tag{21}$$

where $\varphi_o$ is angle of initial position 1. Origin of above formula is given in book [4], and also in author's first work about oscillator [5].

According Newton's third law of action and reaction, tension force *T* in pendulum handle is transferred on pivot point *O*, but with opposite direction, see force *T'* on picture bellow. In practice they are the same forces and from now on we will use only tension force *T*.




*Picture 3*

Because the pivot point can move only in a vertical direction, only the vertical component of tension force, *Ty,* can perform work. That component is decreased with increase of angle *φ*, and additionally with decrease of tension force *T.*

For initial angle of 90 degrees (position 1) formula for vertical component of tension force is:

$$T_y = T\cos(\varphi) = 3Mg\cos^2(\varphi) \tag{22}$$

This force rapidly decreases with increase of critical angle in position 2. If the pendulum were able to overcome mass *m* at great critical angle, then weak tension force *Ty* will perform the work with movement of pivot point downwards, and output work will be small. Because decreased potential energy of the pendulum (2) must be compensated, it means that quotient of efficiency has become very small.

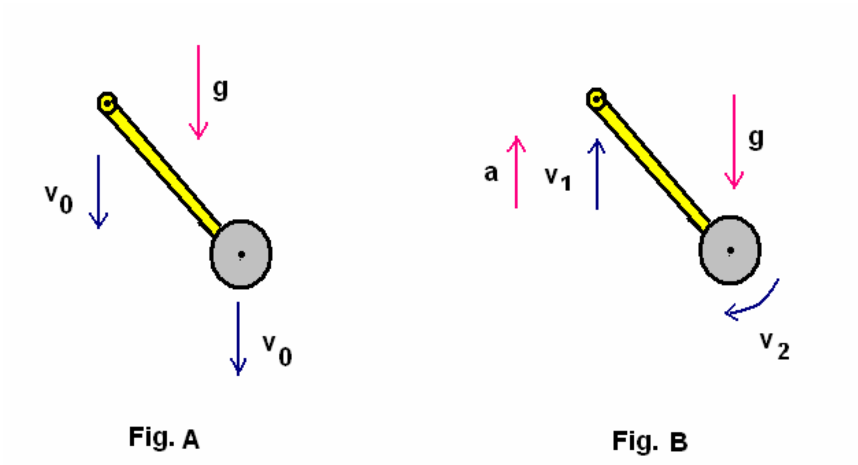
**Pendulum Velocity and Critical Angle**

Kinetic energy of the pendulum is determined by its velocity. If pendulum is close to low position 3, it means that most of potential energy has been transformed into kinetic energy and direction of velocity become almost horizontal.

Pivot point of the pendulum starts moving down from position 2 and will have some acceleration. Its movement downwards doesn't stop in low position 3, but in position 4 when tension force become weak enough that mass *m* on left arm can pull pivot point upwards.

Note that for oscillators which use a spring instead of mass *m*, the pivot point will start moving early and stop going down soon after position 3. Then it will turn and go up and finish the movement in position 4. Usage of springs alone can diminish quotient of efficiency because the pivot point is returned up before position 5, where the pendulum becomes weightless. This means that the centrifugal force will perform an equally positive and negative work and give no over unity energy at all.

Acceleration of pivot point *a* affects the velocity of the pendulum bob the following way. If the pivot point accelerates downwards, that influence is negative on the pendulum because its effect is the same as if gravitation constant *g* becomes smaller i.e. $g' = g - a$. It means that pendulum bob will accelerate slower and the pendulum will have a smaller velocity and kinetic energy in position 3 than usual. It is obvious on figure A on picture below.




*Picture 4*

The pendulum was allowed to fall freely, so that gravitational acceleration would equally affect the pendulum bob and pivot point. It is obvious that the pendulum will never swing around pivot point. If pivot point accelerates upwards as on figure B, the pendulum will accelerate faster than usual and will receive additional energy. Effect is the same as if gravitational constant become bigger i.e. $g' = g + a$.

Situation in case of two stage oscillator, from position 2 till position 3 is the same as on figure A on the above picture, because the pivot point and pendulum bob accelerate downwards and pendulum loses energy. Situation is better from position 3 till position 4 because pendulum bob starts going up and its acceleration has opposite direction than acceleration of pivot point.

In order to improve situation from position 2 till position 3, it is better to have position 2 as low as possible because most of potential energy of the pendulum will be converted into kinetic energy and any change of gravitational constant will not be important anymore. However, return position 4 should be close to weightless position 5 and some compromise must be made or the lever should be locked in low position 4 and released when the pendulum comes close to position 5.

More details about influence of acceleration of pivot point on pendulum velocity can be found in author's work about theory of gravitational machines [6].

## CONCLUSION

In this work are determined maximal possible over unity quotients of efficiency of the machine, under certain conditions. They were not known before and there was a lot of guessing about it. A machine without energy consumer would behave as if it has a much bigger quotient of efficiency than a machine with a water pump attached to it. The reason was partial oscillation of energy.

All previous effort of research work had been directed towards shortening of movement of the pivot point and increase of mass of the pendulum. Shortening of movement of pivot point was done by cutting length $L_2$ of right lever arm. The above logic had some success, but it had a limit because lever had mass too and its axis some definite width. Without consumer attached, the oscillator had the best efficiency quotient if proportion of lever arms $L1: L2$ was equal to 3.5 : 1.

In this work it has been proven mathematically that the length of pendulum has an influence on centrifugal force and quotient of efficiency. The proposed model had been simplified because the mass of the lever was disregarded and also the small horizontal movement of pivot point of oscillator from *picture 1*.

Mass on left arm of the lever has inertia and setting critical angle in low position can not travel far because the system needs time to move mass $m$. Oscillators which uses spring instead of mass $m$ have less problem with inertia, but their pivot point starts moving down very early and start moving up after low position 3. They finish movement up in position 4. This means that they don't use the logic of using a strong centrifugal force to perform useful work and the weightless state to set the pivot point in its initial position. Their quotient of efficiency could be low, unless consumer controlled the lever movement by its internal resistance.

The extension of the pendulum handle not only keeps centrifugal force constant, in the low position, but also slows the pendulum down and allows the critical angle to go down more because the pendulum has more time to move mass $m$ on the lever. The only problem with this logic is that of slower work of the machine, but the benefits are many.

## REFERENCES

[1] Jovan Marjanovic, *Angular Momentum and Over Unity*, 2010
http://www.veljkomilkovic.com/Docs/Jovan_Marjanovic_Angular_Momentum_and_Overunity.pdf

[2] Two-Stage Mechanical Oscillator of Veljko Milkovic
http://www.veljkomilkovic.com/OscilacijeEng.html

[3] Raymond Head video „Higher pendulum more weight lifted", YouTube.com, 2009
http://www.youtube.com/watch?v=TMq53NPttUk

[4] Dr. Lazar Rusov, *MEHANIKA III, DINAMIKA*, Naucna Knjiga, Beograd, 1994

[5] Jovan Marjanovic, *Keys of Gravity Machines*, 2008
http://www.veljkomilkovic.com/Images/Jovan_Marjanovic_Key_of_Gravity_Machines.pdf

[6] Jovan Marjanovic, *Theory of Gravity Machines*, 2010
http://www.veljkomilkovic.com/Docs/Jovan_Marjanovic_Theory_of_Gravity_Machines.pdf

Published in Novi Sad, Serbia
**May 05, 2011**

http://www.veljkomilkovic.com

**Jovan Marjanovic**
M.Sc. in Electrical Engineering

Jovan Marjanović