MECHANICAL FEEDBACK LOOP PROBLEMS AND POSSIBLE SOLUTIONS FOR THE TWO STAGE OSCILLATOR OF VELJKO MILKOVIC

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ABSTRACT

The goal of this work is to share findings and problems in an attempt to close mechanical feedback loop for two stage mechanical oscillator of Veljko Milkovic (www.veljkomilkovic.com). This work is a continuation of my first work [1] with some additional insights after several attempts to finish the mechanical feedback loop.

In this work I will try to:

- point out omissions in modeling the system and suggest solutions,

- further discuss issues with mechanical feedback loops,

- explain the problem of passing energy to the pendulum.

Key words: Pendulum, Oscillator, Perpetuum Mobile, Mechanical Feedback Loop.

INTRODUCTION

After my initial failure to construct a mechanical feedback loop using a wooden model I had constructed, my conclusion was that a simple mechanical feedback loop could only work if instead of using a pendulum, an unbalanced wheel was used, which rotates in one direction only. Explanation of that attempt is given in my first work [1]. After publishing that document and further thinking about the influence of the movement of the pendulum pivot up or down, it become clear to me that the influences of the lever arm of the oscillator on the pendulum didn't cancel each other, but negatively affect the pendulum and which takes energy from it. This means that visual observation was deceiving and because the lever arm negatively influenced the pendulum swing, it wasn't possible anymore to claim that the two stage oscillator is an over unity machine, because the pendulum kept pumping energy into the lever and there was no return influence on it.

In the same work as mentioned above[1] I explained the errors in calculation of the output energy using the formula for potential energy and found that the efficiency quotient was far below that given in the first work by Jovan Bebic. All these facts pointed out that claim that this machine is over unity was slim. However, the latest measurement done by Jovan Bebic using fish scale and output generator gave some hope. I didn't have a fish scale nor an output generator or any other sophisticated tool for measurement and had to rely on the work of other people.

Thinking about theory of 19th century English Royal Astronomer sir George Airy which said that "*if position dependence of a force acting on a body was abrogated (the force should depend not on the position of the body at the instant of the force's action, but on its position at some time preceding that action), then the theorem preventing perpetual motion from what on the surface appeared to be an apparently conservative force would no longer be applicable*" I come to the conclusion that using a spring locked by a lever after loading and released at some time latter the above theorem could be satisfied. An example would be a spring in a gun or a riffle. You compress a spring in a gun at one time and fire it latter. This could possibly create perpetuum mobile even if the original oscillator wasn't an over unity machine. I constructed a new wooden oscillator twice as big as the first one, with a pendulum rod about one meter long and started to experiment with it.

MATHEMATICAL MODELS

To understand the problems with mathematical models of the oscillator the movement of pivot point of the pendulum should be analyzed. Pendulum starts from the position 1. At position 2, pendulum will have enough velocity to create strong tension force *T* in the handle. According to Newton's third law, the same force *T'* will appear in the pivot point *O*, but with opposite direction. That force will start pulling pivot point *O* downwards.

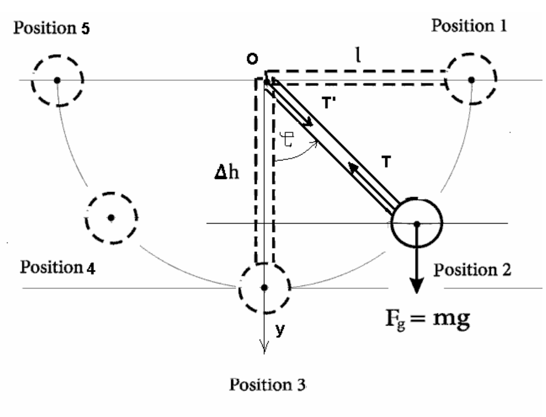


Fig. 1

The lever with mass m_2 on its left arm (see down Figure 2) will not move at all until pendulum handle comes to position 2 from position 1. Left side of the lever will go up when pendulum passes position 2 till position 4. Then it will rapidly go down from position 4 and strike the pillar at position 5 (and pass some energy to it). Lever mass will stay down without movement until pendulum comes back from position 5 to position 4.

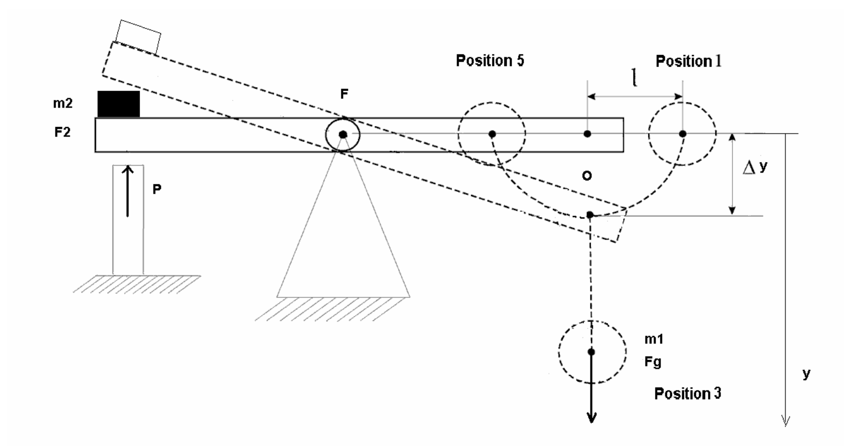


Figure 2.

So, there are three stages of the lever movement here:

1) From position 1 till position 2 there is no movement of the pivot of the pendulum and all formulas for a pendulum with fixed pendulum pivot can be correctly applied.

2) From position 2 till position 4 pivot point *O* will go down and mass m_2 will go up. Although tension force *T* in the handle is strongest in position 3 the maximum height of the level mass m_2 is not in that position. Mass m_2 will continue going up till position 4 when tension force become the same as weight of the mass m_2.

3) From position 4 till position 5 mass m_2 will rapidly go down, strike the pillar P and stay down until pendulum comes back from position 5 to position 4. The period of the time from position 5 till position 4 is the same as stage 1).

Note that when lever mass m_2 is down, pendulum will still continue to swing and there is not any connection between the angle of the pendulum handle and angle of the lever arms. I have seen many mathematical models which connect these two angles in formulas for potential and kinetic energy of the system used for Lagrangian energy analysis.

The correct method would be to break the model into three models for each of the above stages. Starting variables for the next stage would be ending variables for the previous stage.

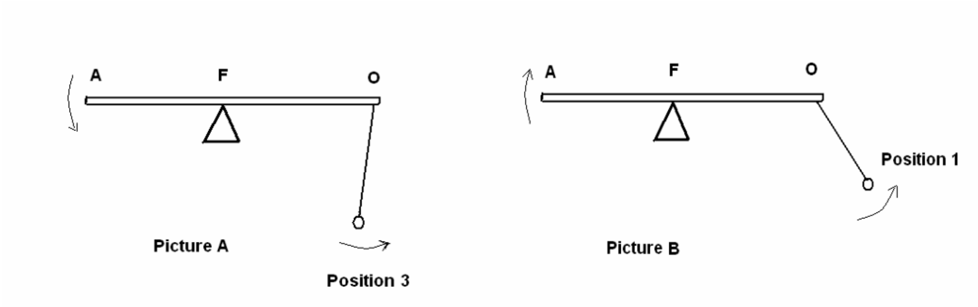
There is one reason to break stage 2, into two stages. From position 2 until position 4, the pivot point *O* will go down all the time. From position 2 until position 3, the pendulum bob will move from the right to the left side and downwards (the same as pivot point *O*). From position 3 until position 4, the pendulum bob will still keep moving from right side towards the left one, but upwards, which is opposite of the movement of the pivot point *O*. The significance of this will become clear in next chapter.

INFLUENCE OF THE LEVER ARM ON THE PENDULUM

If a lever arm on the pendulum side is shorter that the other one, that influence would be less visible. I noticed that influence some time ago and tried to control the lever movement to fix this negative influence. From personal experiments, I found that the pivot of the pendulum should move in the opposite direction of the pendulum bob in order to have a positive influence on the pendulum swing.

The theoretical reason for the influence is this; if the pivot point *O,* moves upwards with an acceleration, a, the effective value of the gravitational constant g is $g' = g + a$, the pendulum gets extra energy and the period of the pendulum decreases. If *O* accelerates downwards with an acceleration, a, the effective value of g is $g' = g - a$, the period of the pendulum increases and the pendulum loses some energy. If the pendulum is allowed to fall freely under the action of gravity (so that $a = g$) the pendulum would stop swinging, tangential velocity of the pendulum bob would be zero and length of its period infinite.

Suggested demonstration given by a university professor is given below:

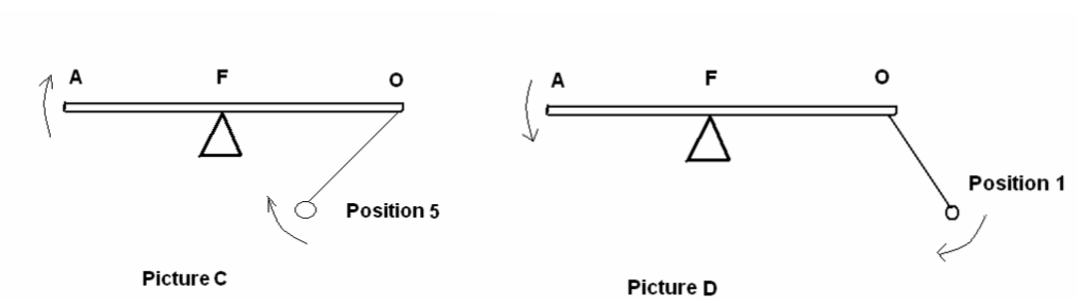


While supporting the left side of the lever A with your hand, set the pendulum swinging. As the bob moves through the lowest point at position 3, move the hand downwards and when the bob reaches position 1 move the hand upwards. Repeat this on the reverse journey. Over a number of cycles the end result is that, because the pivot point *O* of the pendulum accelerates upwards when the bob is at low position, the bob speeds up. If the pivot point *O* is moved down when the pendulum bob is at low position 3, the pendulum reduces its amplitude (and its total energy).

However, my personal experience is different. The most important thing was to guess appropriate rhythm by hand. If the hand moved too fast nothing would be achieved. The next important thing was that pivot point and pendulum bob moved in opposite directions.

That is logical because if the pivot point and pendulum bob moved in the same direction with the same velocity then pendulum bob would never be able to go around pivot point.

Down is the way I found to be the best to accelerate pendulum manually.



While pendulum bob was moving upwards from position 4 till position 5 it was necessary to push pivot point down by moving point A upwards. At opposite side in position 1, I reversed the lever movement when the pendulum was going downwards. In this way, acceleration of the pendulum was very fast. Again, the rhythm of the hand was very important. The hand movement, when the bob was in position 3, spoiled the pendulum swing.

I am not saying that the theory of the university professor who suggested experiments given on picture A and picture B are wrong. There is a good work "*How to pump a swing*" [2] with mathematical analysis of how a child can drive a swing. The author called the principle of raising the center of the mass in position 3 in order to increase the speed "conservation of angular momentum". However, that analysis was for the pendulum with fixed pivot point.

MOVEMENTS OF THE PIVOT POINT AND PENDULUM BOB IN OSCILLATOR

By observing the work of the oscillator, it can be seen that the pivot point is going down from position 2 till position 4 and the pendulum bob is also going down from position 2 till position 3 (see Fig. 1). So, the whole pendulum is going down from position 2 till position 3 and it is similar as if the pendulum was allowed to fall down freely. It would stop swinging after some time.

From position 3 till position 4, the pivot point is still going down, but the pendulum bob is going up. This means that although the pivot point is going down, it helps the pendulum bob to come to its end position 5 faster. It is the same as the period of the oscillation becomes shorter. Looking into the formula for period $P = 2 \pi \sqrt{(l / g)}$ it can be seen that a shorter period means that the effective gravitation constant g become bigger. This can be confusing, because it has been said on the previous page that the effective gravitation constant can become bigger if the pivot point is accelerating upwards only. However, that was valid only if the movement of the pendulum bob was disregarded and supposed to be at position 3.

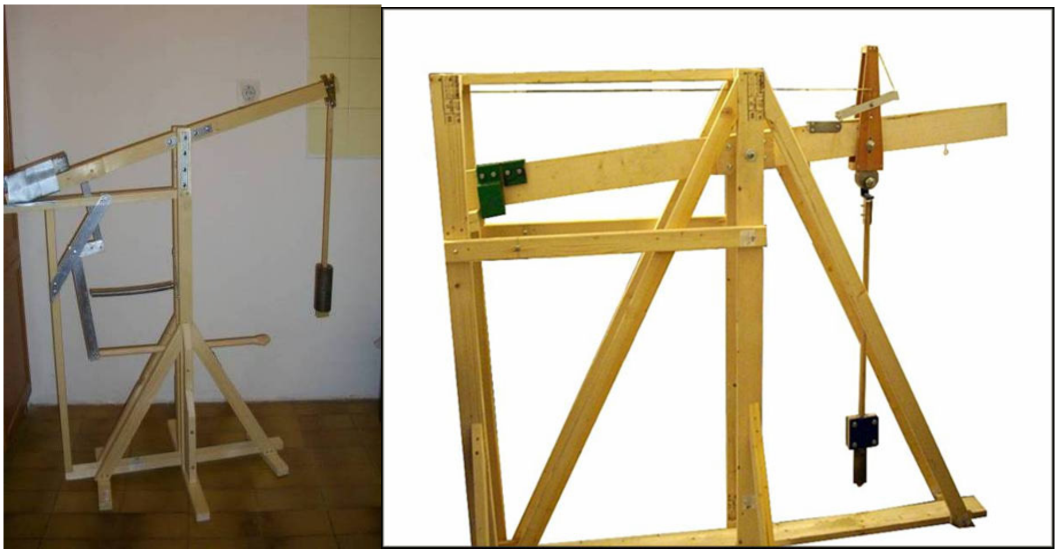
Once the pendulum bob passes position 4, the pivot point will go up and mass m_2 will strike down towards the pillar (around position 5). This means that both, the pendulum bob and the pivot point are going up from position 4 until position 5. Because the complete pendulum is going in the same direction (this time up) the period of oscillation will became longer. It is the same as the effective gravitation constant g becoming smaller and for a smaller g, the energy of the pendulum system is also smaller. Again, this seems to contradict what was said on a previous page, that upward movement of the pivot point would increase the effective gravitation constant. The statement on the previous page is valid only for small movements of the pendulum (around position 3).

The most important thing to remember for large movements of the pendulum bob is that if the pivot point and the bob are going in the same direction, energy would be lost, and if they move in opposite directions energy would be increased. This can be easily understood if we imagine that the pivot point and the pendulum bob are moving in the same direction (any one) with the same velocity. The bob wouldn't be able to go around the pivot point at all. The period would be infinite and according to the formula for period, it is possible only if the gravitation constant g is zero. If they moved in opposite directions, it would shorten the period.

From everything said above, it can be seen that movement from position 1 until position 2 is not important because the lever arm (and pivot point O) are not moving at all. From position 2, until position 3, the movement is negative, because the pendulum bob and the pivot point move in the same direction (down). From position, 3 until position 4, it is positive. The movement from position 4 to position 5 is also negative. The same logic can be applied when the pendulum starts coming back from position 5. So, there are twice as many negative movements than there are positive ones and it is obvious that the pendulum system, with movable pivot point, will keep losing energy, besides friction loses.

FIXING THE NEGATIVE INFLUENCE BY CONTROLING THE LEVER ARM

My first idea to fix the problem was to control the movement of the oscillator lever in such a way that the pivot point and the pendulum always move in opposite directions. That would be possible if a lever arm was locked with a system of small levers and possibly using a locked spring. The spring should be released at a different time to push the lever mass m_2 up. So, the spring would be used to accumulate mechanical energy to be used at a different time. This was exactly what the theorem of Sir George Airy required for a system to have perpetual motion. However, I found using springs to complicate the matter because of unwanted oscillations and decided to drop it out. Below are wooden models with the first feedback loop described in my first work [1] and my last feedback loop attempt.

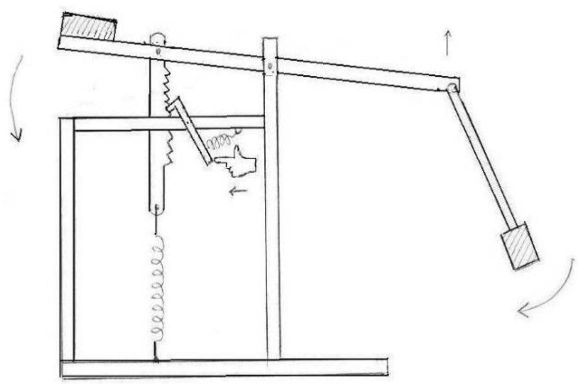


I found two points for the control of the lever. One is when the pendulum is in the down position and the other is on its maximum upper position. Because the pendulum keeps moving left and right, we actually have four points to control. For the control of the lever when the pendulum was in its upper positions I would lock the left lever arm (with mass m_2) when it was in its upper position and allow it to drop down when the pendulum comes at the right place. For the control of the lever when the pendulum was in its low position, it was necessary to stop the left lever arm from going up until the pendulum came at the proper place.

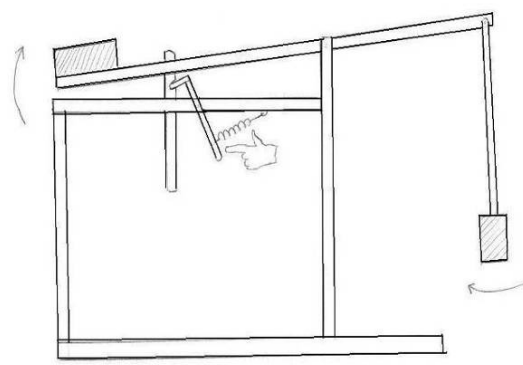
To avoid unnecessary work, I made the decision not to close the feedback loop, but to only make a system for controlling the movement of the lever. I would manually release the lever with my hand at the appropriate time and check if there was any progress.

The control of the upper pendulum point went like this: The mass m_2 of the left lever arm was allowed to go up as much as it could, but wouldn't be able drop down until manually released by pressing a control lever. Because the dropping down of the mass m_2 would move the pivot point upwards, it should be released only when the pendulum bob was moving downwards (in the opposite direction). So, I would press the control lever to allow mass m_2 to drop down when the pendulum turned back from position 5, towards position 4 (see Fig. 1). The same was applicable for the movement from position 1 towards position 2, but because pendulum was too fast for my hand, I would control only one point at a time.

For controlling the down position, it was necessary to lock the left lever arm so as it would not go up (and push the pivot point down) until the pendulum passed position 2 and came close to position 3. The left lever arm should be allowed to go up (and pivot point down) when the pendulum passes position 3 and starts going up towards position 4. However, it was necessary to release the left lever arm before the pendulum came to position 3, because the lever didn't have time to move up if released too late due to its inertia.



The lever control for the pendulum in position 1 and 5



The lever arm control for the pendulum in low position 3

The control of the two down points of the pendulum has improved, about 20%, the duration of the oscillations. This I found logical because the movement of the pendulum and the pivot point is positive (in opposite directions) from position 3 to position 4 and negative from position 2 until position 3 (in the same direction). Because it was necessary to release the lever before position 3, to use the maximum tension of the pendulum, it was not possible to expect a lot of improvement by controlling the down pendulum point. However, I found this 20% to be worthless for practical purposes.

My experiments to control the lever arms around position 1 and position 5 gave no positive results, but also no negative ones. I found that any vertical movement of a lever arm didn't affect the pendulum at all if it was in position 1 or position 5 (90 degrees).

I was guessing that the pendulum should be influenced that way, that movement is in the direction of its rod. For example, if a pendulum is in the low position 3, then the lever movements up and down would affect the pendulum and if the pendulum was in its horizontal position 1 or 5, then movements left and right (of its pivot) would have an influence on the pendulum.

FIXING THE NEGATIVE INFLUENCE BY CONTROLING PIVOT POINT

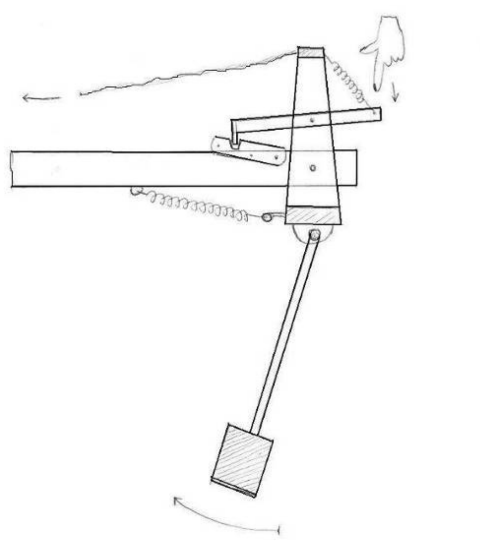
After my failure to obtain good positive results by controlling lever arm, my next step was to see what could be done on the pendulum side. The fact was, that movements of the pivot point had negative influence on the pendulum swing. If it was possible to compensate that movement and even turn it in such a way as to have a positive influence, then perpetual motion could be achieved. The only way to do that on the pendulum side, is to construct an oscillator to have a movable pivot point of the pendulum which could move relative to its lever arm.

Because control of the lever arm when the pendulum was in the down position gave only 20% improvement and pendulum was very heavy at that position, the control of the pivot point when pendulum was in position 3 was out of the question. So, the only option left is to move pivot point when pendulum bob was around position 1 or position 5. If the starting angle was 90 degrees then the pendulum bob would come into a weightless state in these two positions.

Because I had already come to the conclusion that it would be best to move the pivot point left and right in these two positions, my first idea was to use a box with pendulum attached to it and the box would be moveable along right lever arm. A spring could be attached to the box and a string would connect mass m_2 with the box. Mass m_2 would strike the pillar when pendulum come to position 1 and it would pull the box and extend the spring. Next, the string would push the box back when pendulum was on the way back from position 1 towards position 2 (see Fig. 1). This way, the pivot point and the pendulum bob would move in opposite directions. However, it was hard to make a wooden box to move along a wooden lever arm without heavy friction. I was reluctant to install 10 small wheels onto the box to diminish the friction and decided to use a new driver instead of the box.

This new driver was small pendulum which could swing left and right around the axis in right lever arm. This driver would move the pivot point of the original pendulum not only left and right, but also a little bit up and down. Again, I decided not to install a complete feedback loop but only a control system to lock the driver and then to manually release it around position 1 and 5.

When the pendulum comes into position 1 or 5 it was easy to turn the driver manually towards the pendulum bob. However, it was necessary to lock it there for some time before releasing it, in order to see the amplitude of the pendulum increasing. Initially I used one, then two springs in order to balance the driver, but again I dropped it as springs would make the system more unstable and it was necessary to lock the driver very quickly in order to stop the oscillations of the springs. The control system was originally made from aluminum plates, then I used steel plates from door hinges to remove the friction. However, it still was hard to unlock it manually and sometimes it would unlock itself after the lever arm stroke the pillar. Then I used my hand to lock the driver and observe the behavior of the system.



The driver for the control of the pivot point of the pendulum

It was impossible for me to manually control both upper points in position 1 and position 5 as it was necessary to unlock the driver and leave it to go to the opposite position to see some amplitude increase. The movements were similar to those in picture C and picture D on page 4. The biggest problem for manual driving was to take care about appropriate rhythm. If the hand was a little bit late it would be hard to turn the driver on side towards the pendulum bob and if released prematurely, the driver would also swing, but chaotically and would corrupt and stop the pendulum swings.

Finally, I come to conclusion that it was hard to control the driver even by my hand and using simple mechanical system of small levers and some springs was out of question. The main problem was the timing and the rhythm. It is well known from the theory of oscillations that in order to keep amplitude of the system increasing, a resonance should be created by using external force which had a frequency the same as original system. In order to increase the amplitude of the pendulum an external force should follow the pendulum with similar velocity, but little bit faster in order to be able to come close and press the pendulum and pass the energy to it. Because the pendulum has variable velocity the external force must be smart enough to follow it to pass the energy to it. This wouldn't be easy task even for sophisticated systems with electric motor and sensors. At the end I had to give up possibility to create feedback loop with simple mechanical control system.

THE PROBLEM OF PASSING ENERGY TO THE PENDULUM

In my first work [1] it has already been said that passing energy to the pendulum could be tricky. Manually it was easy to pass energy by tapping the pendulum somewhere around position 1 or 5 without thinking much how actually it works. The hand would find a way to do it right, but using a mechanical system to do that is not so easy. Mr. Milkovic also believes that the oscillator should be used in such a way that we should disregard the initial raising of the pendulum into position 1 and only measure how much energy should be added to the pendulum after swing starts and how much is gained on the lever side. His reason for that was because it was so easy to manually pump the water with such a system without getting tired or feeling pain in muscles of the arm.

After some thinking about opinion of Mr. Milkovic I come to the conclusion that his idea is not in vain. The reason is this:

A well known fact from physics is that work done by a force along the path the force passed is equivalent to the energy the force spent. If the force was pushing an object it would pass some energy to that object. If the object was too heavy the force wouldn't be able to move the object nor pass the energy to it. If the force was in our muscles we would feel tired after futile effort to push the heavy object, and we wouldn't be able to pass any energy to it. So, how to solve the problem and push the heavy object and pass small energy to it?

Another known fact from the physics is that two forces can be added to each other as vectors. If two forces act in the same direction than resultant force will have intensity as summary of both forces. If the resultant force was able to push the heavy object, then it would pass some energy to that object which is equal as if each individual force was able to pass corresponding energy to the object. So, although each individual force wasn't able to push the heavy object and pass any energy to it, together they were able to push the object and pass corresponding energy to the object.

In the pendulum system we have a force of gravity which swings back and forth and converts the potential energy to the mechanical and opposite. So, if we act in the direction of the force, we can pass some small energy by a simple tap of the hand, because, however small the energy of the hand, it will be added to the existing force in the pendulum and be passed to the total energy of the pendulum. Here we can see active the principle “Together we can succeed”.

CONLUSION

As said in the previous paragraph, I had to abandon the project of using simple mechanical system of some levers and springs to control the pivot point of the pendulum and create positive feedback loop. The rhythm was the last problem I wasn't able to fix using simple metal pieces and simple tools to create control mechanism.

The possible solution would be to use an electric motor with sensors and some electronics to control the movement of the pivot point by motor. Another way would be to try to use small motor or mechanical mechanism which would be able to constantly pass small energy to the pendulum or at least in some specific points when pendulum comes close to weightless state in position 1 or position 5, or maybe when pendulum comes in position 3 (see Fig. 1) where the speed is the biggest. The energy should be taken from the lever mass m_2. If the lever wasn't able to supply enough energy, then the system is not over unity. The last thing then would be to try to minimize energy usage by using it at specific time and points only.

We decided to share our insights and problems connected to a feedback loop for the two stage mechanical oscillator in order to help the people who are willing to try to replicate and close this system themselves. Still, we can frequently see on various internet sites correspondence where some people are suspicious as to why Mr. Milkovic never closed the feedback loop for the system. Some people keep sending us interesting theoretical (usually animated) pictures and ask Mr. Milkovic to try it and then become upset if he failed to try it. From my experience, I must say that any theoretical picture works nicely on a computer presentation, but in most cases is worthless for usage in practice. Because Mr. Milkovic doesn't have a professional scientific laboratory, nor a factory, nor a great shop with all possible tools and also the fact that in this country it is not possible to go into a shop and buy the things you need for such a project, he would be most thankful for pictures which came from practical experience only.

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