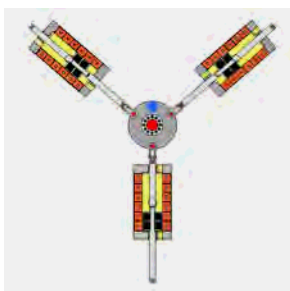


Vladimir Markovic

Logic, explanations and math of SP units 2010/1



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SP – A NEW APPROACH IN WATER TREATMENT

All people who are involved to the problems of natural sources and human environment will probably agree that after quality of air and atmosphere, the second most important natural element is clean, drinking water. Not only due to our needs of drinking, because the most of other living creatures and vegetation could not survive without water.

Today regarding all known facts it is clear, that there are two main problems connected to water: complete quantity of existing drinking water is on nearly all continents big enough, but regarding specific needs – specially on the poorest continents like Africa, the most of Asia and many parts of Latin America, displacement of available water quantity is definitely not acceptable and it is not offering simple, cheap and easy solutions for serving the most of needs for common use and specially not for needs of irrigation. On other side in medium or highest developed countries the most of water is polluted due to industrial activities, but not less important are just classical organic pollutions as result of concentration of human population in big urban areas.

Many years ago as professional inventor I was asked from some people which were involved in mentioned problems to try inventing and creating some new system, which would be able to solve problems of easier water displacement, but on the cheapest possible way and without opening a new energetic or ecological problems on other important parts of environment.

After nearly 20 years of activities on that field, I find out technical solution, to produce submergible unit, which should be placed on the bottom of every – even smallest and slowest river. My idea was, that complete unit uses part of hydro – dynamic energy of slowly moving water masses as driving source and makes possible that proper device pumps and deliver part of the water to the areas where it is needed.

It is known fact that quantity of theoretically existing hydro - potential power in all flowing waters is incomparably higher, than potential water energy which we are exploring today. Every new demand for further exploitation of this potential energy is connected with extremely high investments because available technology requires a local high energy concentration which means construction of water dams, artificial water - storage lakes, etc. Therefore it is very clear that also in the future we won't be able to place those installations anywhere we would like to have them.

Due to above mentioned problems, since century's engineers are trying to find appropriate technical solutions for the most efficient method to explore at least part of the potential energy from slow flowing waters. Water mill wheel was the first system that worked. Number of that kind of water mills, was in early Middle Ages only in England 5.624 and in whole Europe the number was larger than 50.000. But their relatively low efficiency was never high enough. Reason for that is in fact that it uses only upper layer of water stream, whose characteristics are totally different from entire water current. All described facts tell us that for much bigger efficiency we must perform our exploitation of dynamic energy of slow water current, in biggest possible depths. Based on described laws of Physics I started to think, about inventing turbine which "behave like barrier", and which could be fixed to the bottom of the river to exploit at least a part of that extreme energy. At the beginning I made myself clear that driving - active part or "turbine" can not be shaped on the way like classic water or even wind turbines. Without possibilities to increase local speed of water and

considering that hydrodynamics and aerodynamics are totally different by their effects, problem to be solved was definitely not small. So, I designed a system in which active “wings” shall be shaped like very big surface “barriers” to water stream but on opposite side of the turbine they will automatically turn against the stream – the smallest possible face. On described way, we received extremely large leverage on active side of turbine and very small (16-28 times smaller) on passive side of turbine. At the same time, due to known reductions of efficiency on classic turbine systems caused by speed difference between speed of media and speed of turbine, our design allows to the driving media to produce incomparable longer time of active pressure on each propelled wing with small speed difference between speed of water and rotational speed of wings.



$$N = \frac{V}{O \times 2\pi}$$

N = number of revolution/minute

V = water speed (meters/minute)

O = circumference of turbine (meters)

Such turbine – as presented on picture above must always turn much slower than speed of flowing water is. This means that its circumference speed – even without transferring of energy to other device – is always essentially lower than linear speed of running water.

Form for calculating (N) – number of turns of such turbine against speed of running water is shown beside the upper picture. The circumference speed of such turbine is couple of ten times lower regarding speed of water and that makes possible that each molecule of water, which presses on lifted wing of the turbine is relatively long time applying its pressure effect. Treating water at normal temperature as non squeezable media, we can conclude that molecules of water which actually perform dynamic pressure on every lifted wing of turbine do not press it individually, because from the direction of water flow, presses almost endlessly long chain of following molecules (and kinetic energy). Described case is not valid for known (classic) turbines, because in their case, pressure between the same molecules of running water and driving wings of the turbine can last only couple of hundred times shorter time. Also, this effect causes only partial change of direction of the flowing water and does not cause direct or significant reduction of local water speed, which is in Physics manifested in phenomenon called **Stagnation pressure**.

Stagnation pressure in Physics is clarified as pressure (or by calculation as Force), which is caused from horizontally running water on plain barrier inside of water stream (usually on surface of 1 m²). How enormously high is **Stagnation pressure** we can easily understand from the fact, that all under water carriers of the bridges are always rounded against water flow, because in case of their flat surface they can be easily demolished. On similar way, Energy which effects on wing of classic (and quickly rotating) turbine is couple of ten times lower than Energy which has effect on much larger surface of slowly movable wings of SP turbine.

Dealing with problems regarding renewable energy sources it is very typical that today, the most of efforts refer to exploitation of solar or wind energy. Despite all advantages which moving water masses are offering, efforts to increase exploitation of energy from water stream are today very small even when we know that constancy of exploitation during all 24 hours a day is by water nearly ideal. By the same speed, water has almost 800 times larger pressure on the square meter of flat surface in comparison with air (wind) pressure, etc.

Reason for described situation is very simple. Until today, exploitation of energy of moving water mass was limited on small number of technical solutions: Since centuries known water mill wheels and nearly century known water turbines. But, both mentioned solutions have enormous disadvantage, because their efficiency increases only when water speed is several times higher. That fact enlarges installation costs for several ten thousand times forcing us to create artificial lakes with water dams for local water speed enlargement. The same time, it is known fact that due to geo-physical characteristics of the soil, we will never be in position to place and build dams and artificial lakes on the most location we would like to exploit energy from the movements of water masses.

Water millwheel was the first system that worked, but it has relatively low efficiency. Reason for that is in fact that it uses only upper layer of water stream, whose characteristics are different from water current near the bottom of the river. Here we are talking about simple fact that water (in comparison with air) is not squeezable medium. But this fact refers only to water in the bigger depth because on the top level, coming to the barrier, generally not squeezable water is sliding to the upper direction of the squeezable air and completely loses characteristics of not squeezable media. For instance in the bigger depth, on every square meter of fixed barrier, water causes dynamical pressure, which is (at the same speed) app. 800 times larger than wind pressure on the identical surface of barrier! In that case water, on surfaces of the water wheel wings, does not apply stronger effect of so called **Stagnation pressure**, which always occurs when water hits the barrier.

The best way to understand how big disadvantage is caused by described facts is to be understood only after we consider a very simple physical fact that energy which is present in one mile length of slowly moving river is exactly the same as energy on the same river accumulated in one mile long lake before dam! So, extremely expensive dams and lakes we need only because all known turbines could not offer higher efficiency without much higher water speed - locally increased by tunnels in the dam. Now, if we compare all common river lengths with lengths of all artificially made lakes with dams, comparing whole World, we come to the fact that proportions are larger than 10.000:1 in favor of common river body lengths. This means, that with proper technical solution for consumption of energy from slowly movable river streams, if solution would be cheap and easy to install and use, we could overcome complete worldwide energy received today from all classical hydro - energetic power stations.

Treating theoretical background of power and efficiency possible to be reached by SP units I meet many problems regarding classic known calculations and formulas made for known turbines or propellers. At the first place I recognized that we must deal only with kinetic energy of moving water masses without using known calculations which are nearly always connected with measuring of flow and efficiency inside of the pipe.

Second reason why usually known formulas (Bernoulli or other) are not appropriate for our turbine is in the fact that by known turbines or propellers radial speed of the turbine is always very high. This is the main reason that **Stagnation pressure** effects are by classic turbines very low, what is completely different when treating our SP turbine on which the highest circumference speed is always much smaller than speed of the water.

The third reason for lower efficiency of classic turbines is in the fact that due to high RPM, the back sides of all wings are causing the braking effects because they are pushing water sidewise – out from its straight moving lines. By SP unit wings this effect is opposite and the same time when water is overtaking each lifted SP wing it is causing also part of propelling power on its back side.

Apart from mentioned and always present part of Stagnation pressure which has very high influence to efficiency of our SP unit, it is very important to remember that on the same way as water is not (practically) squeezable it has also some characteristics which shows also its resistance to ductility. This practically means that in open current area driving of our SP blades (wings), water propelling power is not limited only on the surface of wings but also on slightly wider area of the water stream. Of course regarding higher stream speed (than blade turning speed is), it is to be also recognized that water is simultaneously propelling all three active SP blades at once.

By most classical formulas for calculating turbines power - even by formulas composed by the biggest experts on the field of Physics – inside of formulas are included data about turbine efficiency. Results of such calculations are not even theoretically correct because efficiency of any turbine is completely dependent from actual conditions of water quantity and stream speed. Therefore, when water quantity and water stream are changed we can never be certain for how much efficiency of turbine is changed and calculations are becoming a total nonsense. Due to described reason in my formula, I am dealing only with known parameters of physics, and with basic dimensions of used SP unit. This means that results are always correct - even in cases when factors of outer conditions are drastically changed.

After many measures and calculations I found out that formula for calculating power of our SP unit is:

$$P = 21 \times \Sigma A \times r_{max} \times v^2$$

P=power in watts (W)

ΣA =surface of all installed blades (m²)

r_{max} =exterior radius of blades (m)

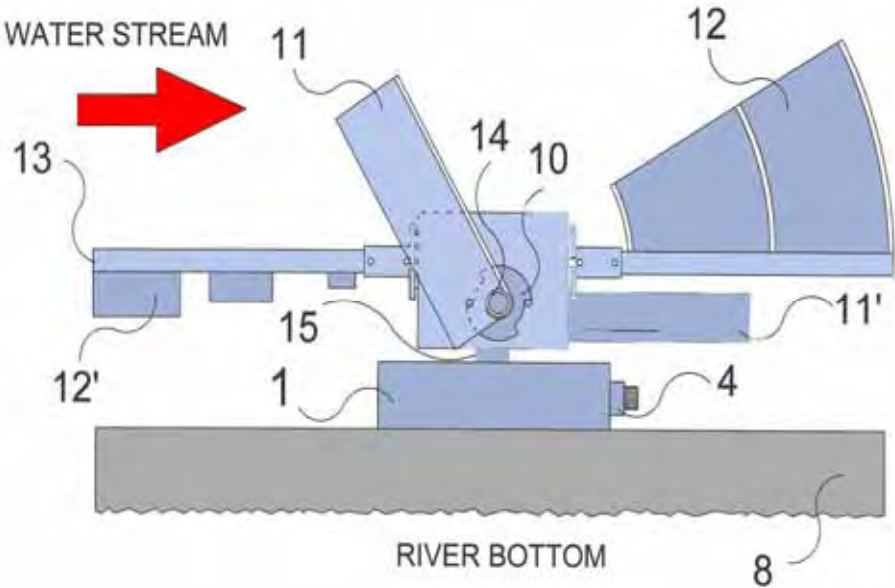
v^2 =water stream speed (m/s)²

Noted formula is proved by comparing it with practical and measured results. We must also consider that sometimes and on some models of SP units each blade could not cover complete surface of 1/6 of circle. Reason for that is in customers enquiries that complete unit must operate in very shallow water. All this means that for example seven meter diameter SP unit (without reducing blades) must operate in at least 4 m deep water, but in that case, with water speed of 3,5 m/s can deliver nearly 34 kW and by 5 m/s around 69 kW of constant power.

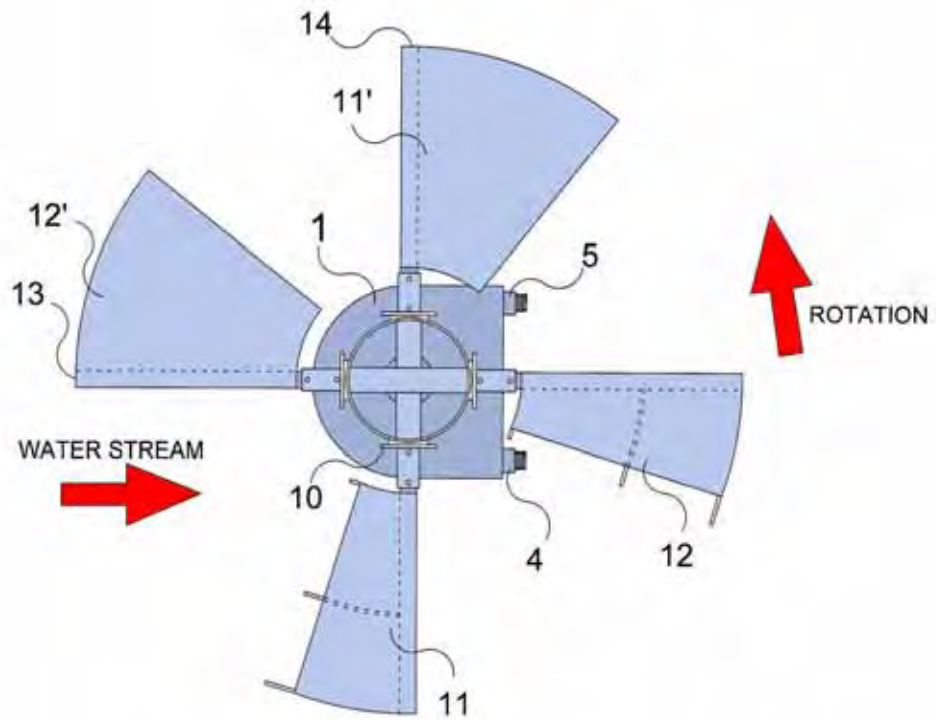
Regarding all mentioned we are still opinion that producing electricity, our SP units are nearly ideal solution for the category of “Pico” generators, where we intend to remain on the powers up to 20 – 70 kW, but it is definitely a fact that also much larger SP units can be designed with possibility to offer more than 100 kW based on constant power. Finally, our last calculations are showing us that here locally and based in 20 years of exploitation time, we can locally produce and install in water “Pico” power units (only 20 kW of constant power) based on price of only 0,0075 EUR per kW/h. It is very possible that someone will not recognize real meanings of that price which is actually for 70 times lower than exploitation price for kWh reached with larger photo cell units or medium big Windmills! Even more, this price is for 8 to 14 times lower than valid prices are for electricity from public nets in different EU countries.

DETAIL EXPLANATION, HOW SP UNIT USES HYDRO – DYNAMIC ENERGY FROM SLOWLY MOVING WATER

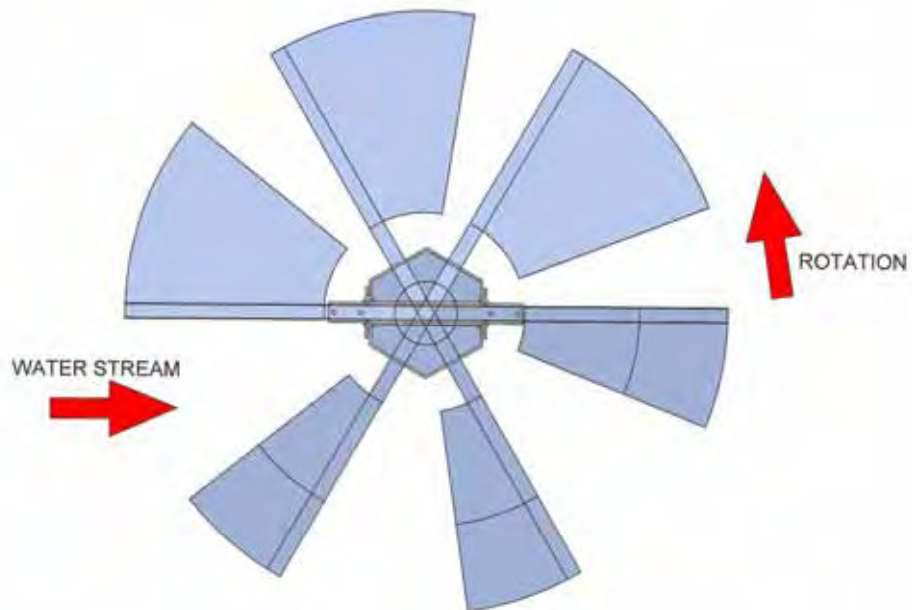
To understand how system works you must understand that our driving “wings” are operating always in pairs – two of them on the same axle. Both wings (for example 12 and 12’) are fixed on the axle 13, but on such way that one wing is fixed on the axle horizontally (12’) and opposite wing (12) is fixed with inclination of approx. 60°.



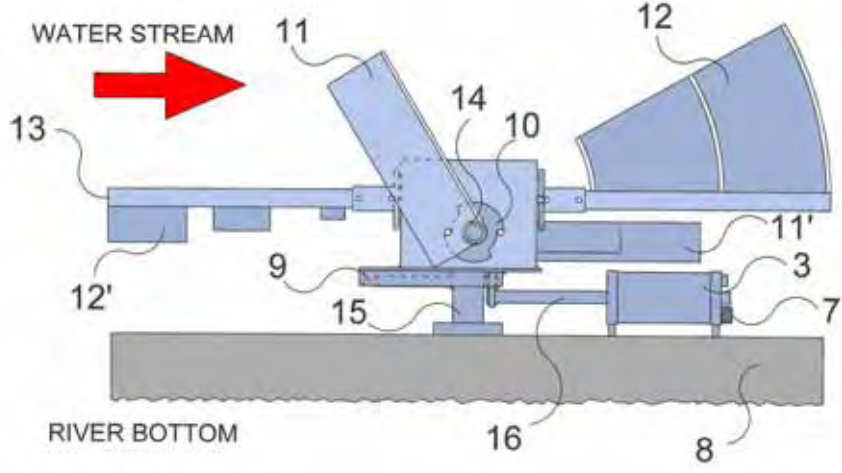
Therefore one side of such propelling system is always turning to the water stream the smallest surface and the second side (wing) is always turning to the water stream very big surface. When complete design turns around vertical axle for more than 180°, water stream is pushing down previously lifted wing and lifting up the opposite - previously horizontal wing.



Described designs we made in more prototypes with 4 and 6 wings and we already measured extremely high efficiencies comparing anything known or existing designs up to these days.



Up to now we made more designs with piston pumps, membrane pumps and very inconvenient centrifugal pumps.



The first prototype from early development



The second prototype with 1,6 m diameter

Several years ago, (due to centrifugal pump) the second prototype was able to deliver only 1 litre per second of water based on 1,2 bar of pressure.

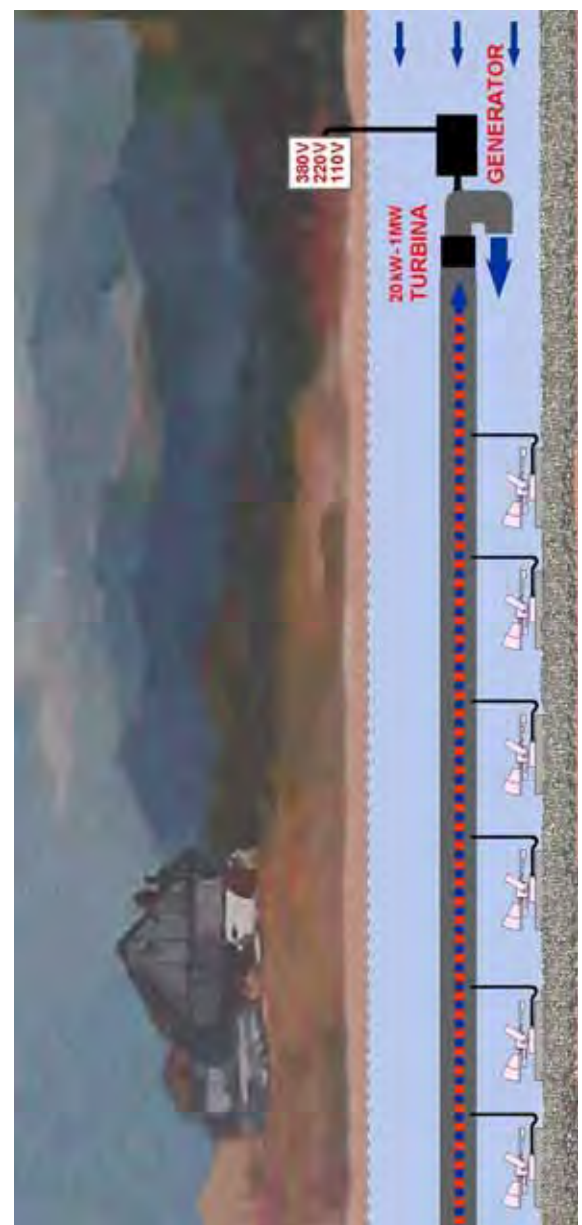


For example, instead of submergible water pump, we can use also submergible air pump which must have attached the inlet hose for air. The opposite end of this hose must be fixed somewhere on the coast and out from the water. In that case, SP unit is sucking the Air and pressing it in very small bubbles on the bottom of the river where deficit of the oxygen is always the biggest – coursing a very quick “burning” of the mud and all kinds of organic pollutions. On described way we shall be able to “turn back” to our rivers a normal “health” which was taken by too high quantity of organic sediments on nearly all bottoms of slower rivers.

Basic idea for higher capacity of irrigation is to connect outlets of more SP units to the bigger diameter of main pipe. This can be done by means of connecting 50, 60, 100 or even more hundreds of SP units to the main pipe with diameter of up to even 2000 millimetres. In such case and specially if we combine such main pipe line with inside Air injecting system (produced from some of connected SP units), we shall be able even to combine consumption of water, transport of and simultaneous cleaning of water from organic pollutions. On the following picture, you can see some other possible application in use of SP units:

For all cases where we could not use a classic system for installing a Power facility, very similar to previously Described connection of more SP units on main pipe, even more hundreds of units and main pipe can be placed on the bottom of the river. But, on the first end of the main pipe we can install a submergible turbine and Power generator which can offer us more than enough electric energy for some local use – or, can be connected to standard Power net system. The costs for such energetic installation are not to be higher than classic Power installation but more important is a fact that described installation can be done also on the places where usual Power systems are not possible.

Of course, main hose can be also lifted on the coast and turbine and generator can be installed on the small building near the coast of the river. It is important that presented solution is ecologically offering the best solution because all facilities can be placed and hidden on the bottom of the river and could not harm any aspect of local environment. In research and development phase we learned that by size, 3 different models of SP units would be welcome on the market: a very small “hobby” unit with capacity of 1 l/second and wings diameter of 1,6 m ; “standard” SP unit with capacity of 3 l/second and wing diameter 2,4 m and “goliath” SP unit with capacity of 7 l/second and wings diameter of 5,5 meters.



SOLENOIDAL GENERATOR

At the end of the year 2009, we succeeded to develop, test and apply patent of new SG generator for production of AC tension with centrally inserted magnets, which for difference from commonly known generators for its activity does not need great number of revolutions from its driving source. By its technical design, each separated part is similar like impulse generator, which works on principle of hammer stroke or spring and were created and in use in laboratories shortly after year 1780, on the first place for gaining impulses of high electric tension. These tensions were gained when proper number of coils of solenoid, which had one or more windings with different number of coils, what made for scientists like Michael Faraday, Lorentz, Maxwell and others, job much easier when they studied fundamental laws of magnetic and electromagnetic phenomena. In subsequent periods, for almost a century, solenoid structures with embedded ferromagnetic core are not exploited for industrial purposes within the meaning of electricity voltage in solenoid for several different reasons, most of whom are set down the problems of low intensity, and in particular the sustainability of permanent magnets themselves that are moving created through an electromagnetic field to rapidly lose its magnetic density. The second problem was the fact that such a generator is not appropriate to create a constant tension, because on both ends we get change of the movement direction of the magnet and at the same time, to alteration of the polarity of inducted voltage. Following the introduction of today known voltage generator and a substantial improvement of the stability and sustainability of the magnets themselves, there have been many inventions and structures, particularly the smaller generating devices incorporating permanent magnets, which many of them are still found in regular use. However, in these cases, the magnets rotate and with their rotation induce formation of voltage, or current in the solenoid coils distributed throughout the periphery of the generator. Practical examples, which are today known in exploitation of solenoid coil with axially movable core, are most common in the use of modern actuator devices, as it is for decades much known anchor for switching on automotive starter and dozens of cases of solenoids equipped with a movable core for valve systems guidance. In the opposite direction, or for the production of continuous electric tension with the axial movement of permanent magnets mounted in the center of the solenoid, there are not any serially produced products in the practical exploitation.

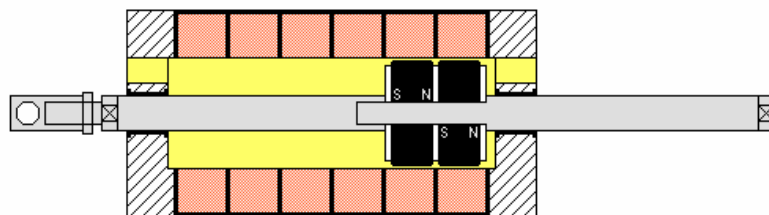


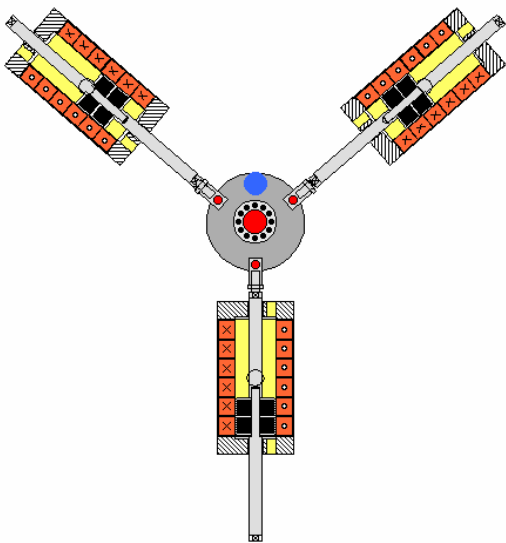
Illustration: Side – section of one out of three segments of our new generator with double permanent magnets and six solenoid coils.

Technical problem, that the SG generator successfully solves, is based on the physical fact that in solenoid we perceive induction of electric tension even when having extremely slow axial movement of the centrally – installed magnets. By that, the solenoid coils developed electric tension, which depends primarily on the number of wire windings and when moving the magnet in one direction induces DC electric tension with properly oriented polarity and

by axial movement of the magnet in the opposite direction, the polarity of the induced voltage also reverses.

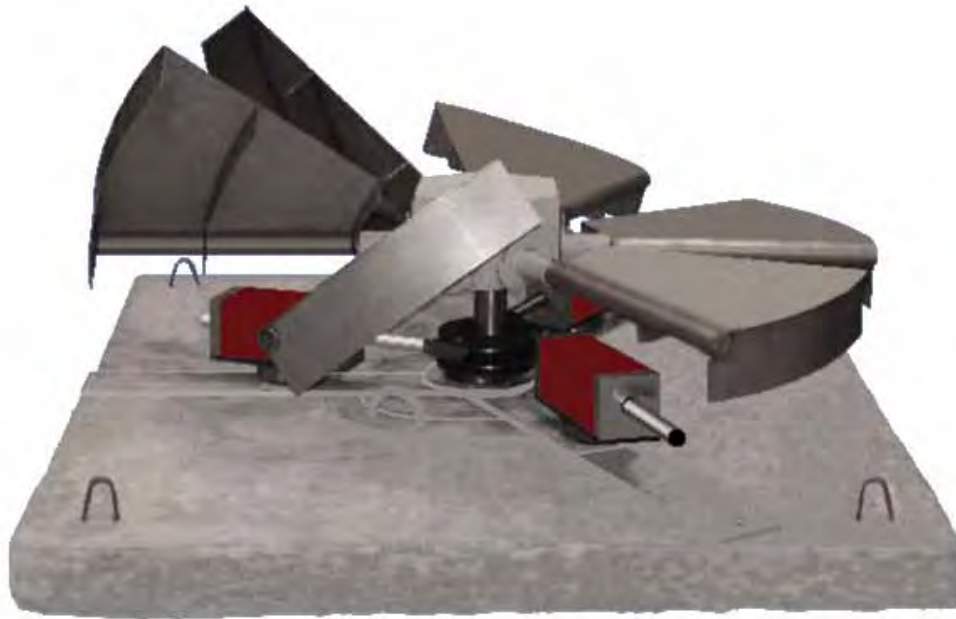
This practically means that the continuous movement of the magnet back to front in solenoids induces AC electric tension, whose frequency depends on number of changes of the direction movements of the magnet itself. In described case will, by the minimum with consumption of electricity and density of magnetic field. Induced voltage depend primarily on the number of wire windings of the solenoids, and by increased frequency of movement magnets back – front - back will mainly grow the available electric current. Described characteristics are fundamentally different from conventional operating characteristics of the known generators, alternators or DC dynamos with permanent magnet, when by small number of revolutions are obtained many interruptions of induction and self – induction. However, despite this seems productive for the generators and dynamos, in fact makes the need for a relatively high number of revolutions of rotor, otherwise it is impossible to achieve sufficient electric tension, or each stator should have unacceptably high number of coils of copper wire which means even unacceptable diameter of design. At the same time on classical generators or dynamos, losses are increased due to transverse magnetic fields coursed by the laminar structure of their magnetic cores, which can not operate at all number of revolutions of the generator by at least approximately the same efficiency. Because of all this and many other well and long known deficiencies of the known generators, the basic idea of SG generator sought to construct a useful electrical generator, which in addition to those problems, it will also not have problems of magnetic gap between the rotor and stator and also with hysteretic losses in the generator plates and long magnetic path through the magnetic segments of the stator.

SG solenoidal generator eliminates quoted and solves the technical objects on such way, that rotating driving media via appropriately designed system always and at the same time eccentric and co-axial moves, three or more axes on which are attached permanent magnets – placed in the centers of three solenoidal housings.



With the help of appropriate eccentric mechanisms, the SG generator have magnets on axles inside solenoids always placed in different positions, what causes that will never come in situation of simultaneous changes in the direction of movement of magnets front – back – front and there will never be a complete absence of induced voltage. Above all, the correct calculation of the magnetic densities and the number of coils of each solenoid or solenoids, a new SG solenoidal generator will explore the possibility of continuous and highly efficient generation of electric tension even at the minimum number of turns of driving media what will eliminate the need for the use of mechanical gearboxes or multipliers between the driving media and the main axle of the generator.

This should allow efficient generation of electricity even at two or even less number of turns per minute, without increasing the losses and at the same time allow the operation of even a hundred times higher number of turns.



Regarding everything mentioned above at the end of last year we started developing more prototypes of SG generator and we found out, that up to this days nowhere in the World something even nearly similar to SG generator was not invented, patented or designed. The most important feature of new SG generator is that its production is extremely cheap, because for example, 20 kW unit will cost in serial production much less than 1.800 EUR and even much stronger 70 kW unit will not cost more than 2.700 EUR. Even more important feature is very easy possibility of this type of generator to produce nearly constant electric tension between 3 – 250 rpm and only electric current and final power are increased by higher number of revolutions. Producing DC impulse power with nearly constant tension, which depends from requires, such generator is drastically reducing price of inverters for possibility to be connected directly to electric net system.

From descriptions of SP units you can find out that we are talking about quite unusual design, which uses only dynamical pressure of slow water current. Even more, by larger water speed, its efficiency becomes lower! Complete design is convenient to drive water pumps (for irrigation) or alternatively to drive directly submergible electric generator. It is also suitable for performing aggressive micro aeration, by which through hose is sucking air from the river bank and injects small bubbles (smaller than 0,2 mm) on the bottom of the river. That causes oxidation of organic pollutions and elimination of the organic mud, which is mostly present on the bottom of the rivers or the water dam lakes. In the following text and pictures you can see the explanations and principles how new self propelled pumps (SP) are working and nearly unbelievable possibilities of their use. Our design is working above all in slowly moving water, when stream speed is higher than 7 m/s, its efficiency even lowers.

Already in the early stages of prototypes of SP devices we have received much criticism about that, that during the operation of device under water, there is a continuous risk that floating dirt, branches and similar could block the operation of propelling pumps or generators. Therefore, when developing SG generators we take care of their protection or complete elimination of such possibilities - for SG generators as well as for pumps and other items that we drive with the SP devices.

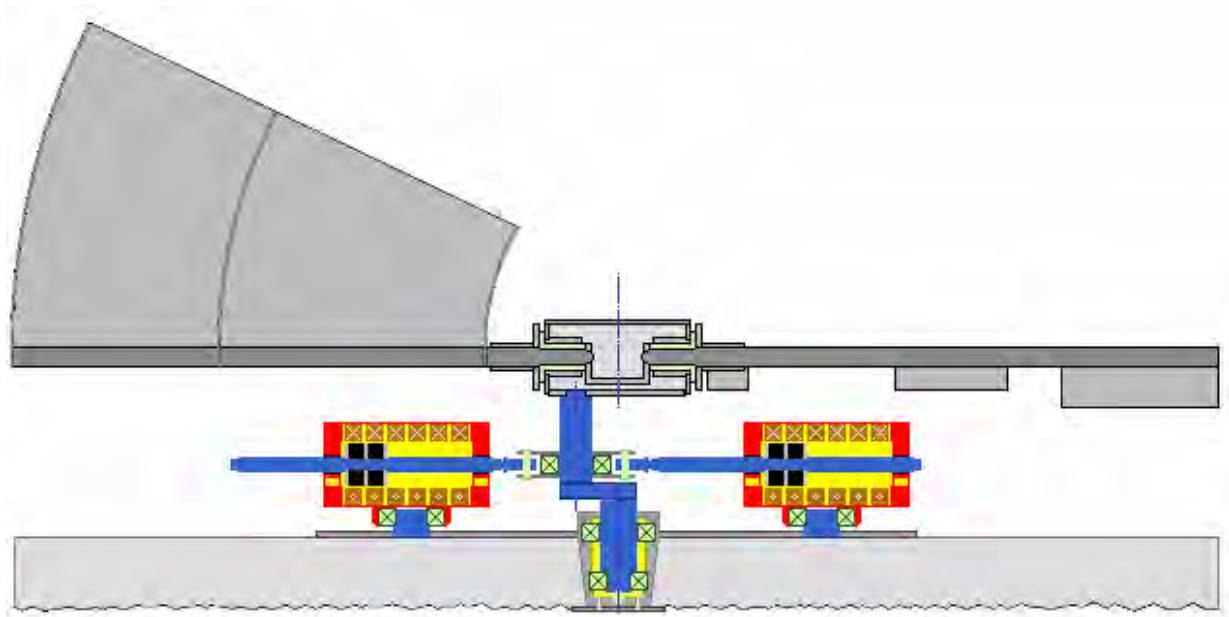


Illustration of the previous system with the SG generator, or piston pumps.

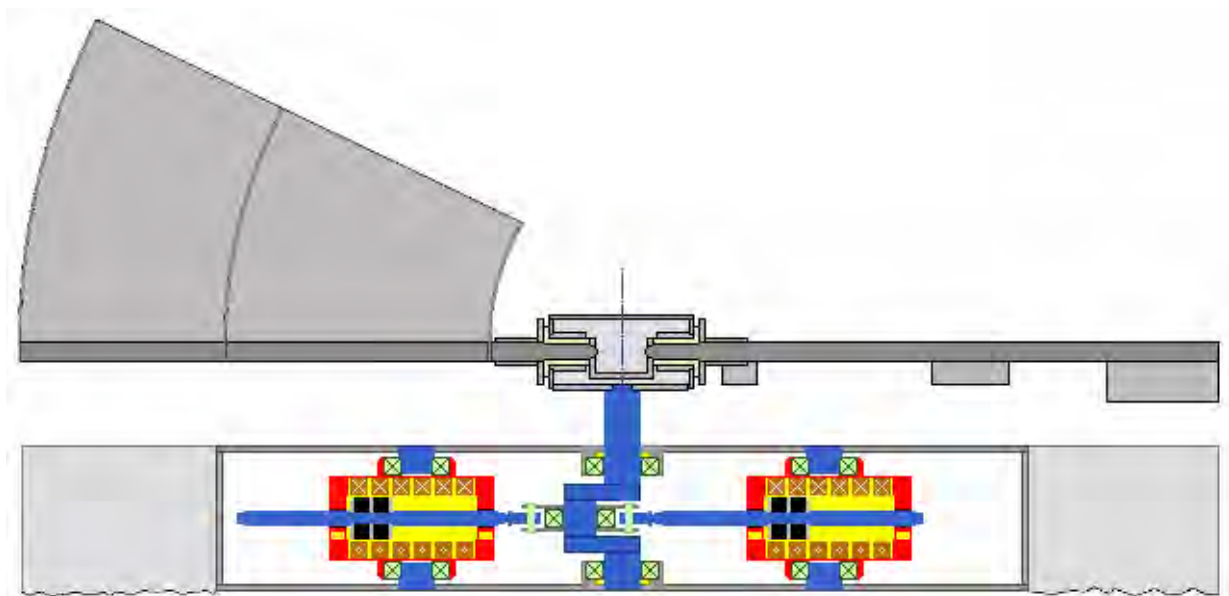
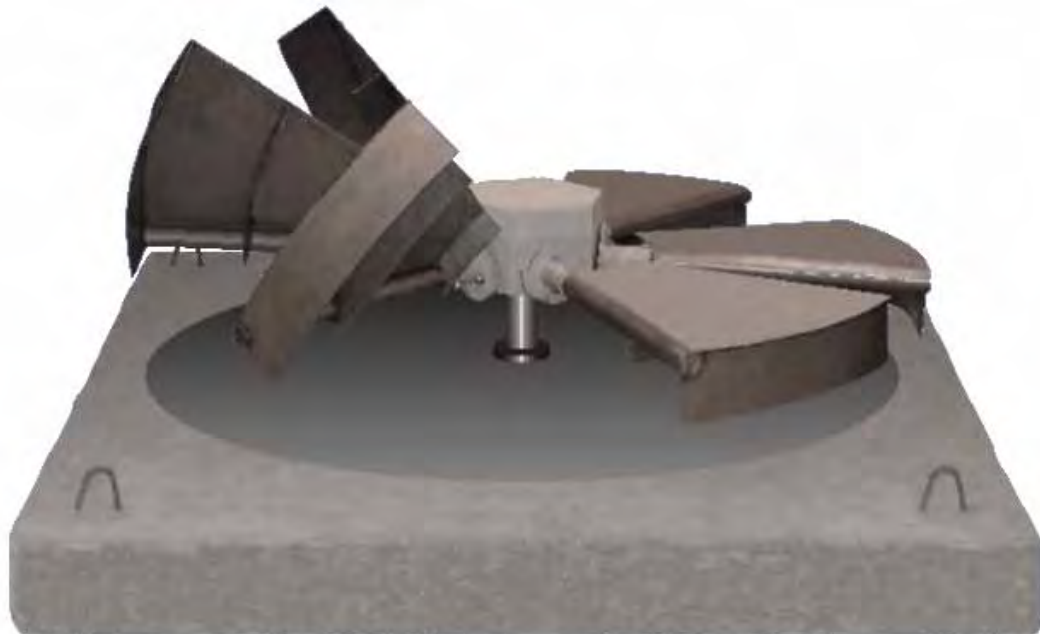


Illustration of the new system with the SG generator or (similar) piston pumps.

Regarding all mentioned we are still opinion that for producing electricity, our SP units are nearly ideal solution for the category of "Pico" power plants, where we intend to remain on the powers up to 25 kW of electric energy. Such production as it seems can achieve far the lowest prices per kWh, which are much lower than the current lowest price. Finally, the latest calculations shows that we will be in this year able to deliver SP units equipped with a

submergible SG generators with power of 20 kW, which will be, on the basis of amortization period of 20 years, able to produce electric energy at a price of only 0.0075 EUR per kWh. Comparing our price (achieved with our SP devices) with prices for kWh received from photo cells (1,4 EUR to 12 EUR for kWh) or even with prices for electricity from larger Windmills (2 EUR to 35 EUR for kWh), we can recognize more hundred times larger difference among all other alternative energy sources.



Even more interesting is comparison of prices of electric energy received from power grid, which in developed world vary between 0,06 and 0,12 EUR for kWh. **By that we find out that the price of energy, which is obtained by the SP devices, is still 8 to 16 times lower, than electricity from the grid and represents the lowest price for gained ecologically cleanest energy in the World.**


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PS: More data, animations and movies you can get on <http://www.izumi.si>