Zero-point-energy Conversion on the basis of the finite propagation-speed of the fields

Prof. Dr. rer. nat. Claus W. Turtur Wolfenbüttel, 19. August 2013

Ostfalia University of Applied Sciences, Wolfenbüttel
Salzdahlumer Straße 46 – 48 38302 Wolfenbüttel Germany
Email: c-w.turtur@ostfalia.de Tel.: (+49) 5331 / 939 – 42220
Internet-page: http://www.ostfalia.de/cms/de/pws/turtur/FundE

Abstract

The zero-point-energy (ZPE) of the electromagnetic waves of the quantum-vacuum (as one of the components of the energy of the empty space), is recognized as a type of utilizable energy within our days now. This is verified by several experimentalists, as well as by the author of the paper presented here. The author of the preceding paper did this verification by performing an experiment of fundamental physics (using an electrostatic rotor) as a guest at the Otto-von-Guericke University in Magdeburg. In connection with his experiment, the author furthermore developed the fundamental theoretical basics for the conversion of zero-point-energy. On the basis of this theory, the zero-point-energy can be converted into each type of classical energy, for the use of every day's practical application. Due to its the functioning-principle, this theory has got the name of theory of "Finite Propagation-Speed of the Interacting Fields" (FPSIF), as can be understood on the following pages.

The fundamental understanding of this theory allows us, to develop, to construct and to build zero-point-energy converters, just as we need them. Two computation-examples for the illustration of this theory have been presented in former publications by the author. This is on the one hand the above-mentioned electrostatic rotor in theory and experiment (which is not very strong with its power of 150 nanoWatts, and thus it is to be understood only as scientific verification), and on the other hand, there is an electromagnetic example, called "electromagnetic-mechanic double resonance converter" (EMDR), which up to now exists only in theory.

The first mentioned example, the electrostatic rotor, goes back to the FPSIF-theory only implicitly, because the flux of the field's energy of the Coulomb-field is one of the consequences of this theory. For the second mentioned example, the EMDR, the author (in all former work) took the FPSIF-theory also only implicitly into account, assuming that its consequences should be included into the physic's laws of Biot-Savart, Lorentz, and the law of electrical induction. The methods of construction of the EMDR-converter have been presented by the author in several publications, finally coming even to presentation, how technical drawings can be developed. But these technical drawings should not be understood literally, because up to now it is not yet clarified, whether the implicit consideration of FPSIF-theory is sufficient for such constructions, or whether the FPSIF-theory must be brought into the computation explicitly. If the last mentioned necessity is really the case, the EMDR-converter should have a driving speed of rotation and a linear velocity (of the magnets) much larger than assumed in all former publications. On the basis of the recent computations, which are presented in the paper here, we know, that this is indeed the case, because of the newest computations presented here, contain the FPSIF-theory explicitly. The result is, that the velocity of the circulating magnets, should be by about two orders of magnitude larger than assumed in the former publications.

With these results, all logical gaps in the construction of ZPE-converters have been closed now, so that the concept for a practical realization of ZPE-magnetic-motors is ready now for implementation. The author of the paper now could build up a ZPE-engine, if he would have a typical scientific-group of co-workers and equipment, as it is usual in the métier of science and development. As a possible preparation for this type of work, the "Magnetic-Mechanic Double Resonance-converter" (MMDR) is presented on the following pages, which can be built up much easier than the EMDR, due to its rather simple functioning-principle. Even the development of the technical design, including the necessary software (algorithm), is presented now with the MMDR, being much easier than with the EMDR, so that

the presentation now can be understood not only as a mere illustration of the computation-method, but we now can see the presented calculation and its results as a real engine-design. On this basis, the practical realization can now begin directly in the laboratory. Furthermore, the MMDR-example as presented here, is much more efficient than the EMDR-example, because the MMDR does not have any electrical wires, and no coils and no capacitors, and thus it is free from electrical losses.

When the presentation of the MMDR-example is finished, a collection of ideas for several other types of ZPE-converters is presented, which all have in common, that they follow the FPSIF-theory and can be constructed on its fundaments. For example, it is sensible, to replace the magnets in motion is by electrons (rotating or oscillating), because such electrons can be brought to extremely high velocity, very easy, due to their very small rest mass. So for instance, we can bring them to about 10 … 20% of the speed of light, by applying only few kiloVolts of electrical voltage. The consequence is, that this allows the FPSIF-theory to be applied with very good efficiency, in order to develop very small and handy ZPE-converters, much smaller than the MMDR. The very end of chapter 5 of the preceding paper is given by references to other types of ZPE-converters, known from literature.

After finishing the sections 1-5 on April-27-2013, I had the impression that my FPSIF-concept for the conversion of ZPE-energy came to a point, that the only possible way to continue my work, would be experiments and practical measurements, because any further theoretical development seemed to be possible, only on the basis of practical investigations in the laboratory. This restriction turned out to be unnecessary, so that I could come to new theoretical findings before going into the laboratory. The point is that I was not satisfied with the results of the sections 1-5, due to the lack of a really motionless converter, this means due to the lack of ZPE-converter without any ponderable matter in motion at all. Encouraged by friends, after a short pause, I came back to my theoretical investigations, and I developed a 100%-motionless ZPE-converter in theory, and the results are described in section 6.

The finite propagation-speed of the interacting fields, as they are necessary for the FPSIF-principle are generated by the yoke of an (electrical) transformer, making benefit of the fact that the magnetic flux on the way from the primary coil to the secondary coil, as well as on the way back from the secondary coil to the primary coil, has to pass the yoke, and as a matter of fact, the propagation-speed of the magnetic flux inside the yoke is of course not infinitely fast. Obviously, same as the magnetic flux, also alterations of the magnetic flux, propagate with finite speed inside the yoke. Especially with regard to alterations of the field-flux, it is generally well-known knowledge, that this alterations propagate with finite speed. Same as electrical signals in electrical conductors (as they are alterations of the electrical flux) propagate with finite speed (--> see transmission line theory [Wik 13e], [Bau 13], [Bos 78]), also alterations of the magnetic flux in the yoke propagate with finite speed (as for instance inside an electrical transformer).

By the way, the finite runtime of electrical signals in electrical conductors, has to be taken into account for the construction of modern computers, in order to make clock-frequencies of microprocessors possible, as we use them nowadays.

Although the propagation speed of magnetic fields and signals in the yoke of transformers are extremely high, this is not really a technical problem, because the generation of extremely fast signals and pulses, is rather usual technology today, which is well under control. Thus the runtime-based delay of the pulses, which are running between the primary and the secondary coil (in both directions) can be utilized quite well, in order to support the necessities of the FPSIF-principle for the conversion of zero-point-energy from the quantum-vacuum. A rather convenient and efficient method for this energy conversion is described in detail in section 6.

Acknowledgement

My very special gratitude goes to my wife, Dr. rer. nat. Olga Turtur, who gave me infinite understanding and mental support, which was necessary to have the power, to withstand all the work, making this paper possible without any help from almost anywhere outside my private house, without co-workers, without laboratory, without equipment, and so on. My wife also helped me practically as far as possible, and she gave me my complete financial budget, by saving money from our housekeeping expenses.

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1. Introduction

In the year of 1840, Julius Robert Meyer discovered the law of energy-conservation [Kra 12]. Since this very beginning of energy-conservation, several types of energy have been discovered and included into this law. Today, this fundamental statement of natural sciences contains several terms, for instance such as: thermal energy, kinetic energy, potential energy (different types, as for instance in the potential of gravitation, or in the Coulomb-potential,…), chemical energy, rest mass ($E=mc^2$), energy of electromagnetic waves (as for instance light), and many others, . . . of which several can be traced back the similar reasons. Nowadays, mankind is on the way, to add a further type of energy to the law of energy-conservation, namely the zero-point-energy of the quantum vacuum.

If anybody wants to utilize this type of energy, we have to find a fundamental principle of physics, which includes this energy into the responsible formula. This condition is always the same condition for all types of energy. For instance numerous formulas of thermodynamics had been developed due to this reason.

Other example: If we want to build electrical and/or mechanical engines, we have two apply the adequate formulas of electrodynamics and/or mechanics. With regard to electrical engines, this gives us the possibility, to begin our considerations with the old and well-known law of Coulomb:

$$\vec{F}_C = \frac{1}{4\pi\varepsilon_0} \cdot \frac{q_1 \cdot q_2}{|\vec{x}_1 - \vec{x}_2|^2} \cdot \frac{\vec{x}_1 - \vec{x}_2}{|\vec{x}_1 - \vec{x}_2|} \qquad (0)$$

If we want to tap a further type of energy (additionally to electromagnetic energy) with an electromagnetic engine, we need fundamental explanation, justifying a supplement to this formula, going back to the very basics of physics. A possible example for such a supplement can be the statement, that the interacting partners, the electrical charges (q_1 , q_2), are to be regarded in motion (with their speed v_1 , v_2), same as the electrostatic field (with its speed c), and the field connects all partners with each other. All components of the consideration, namely all interacting partners as well as all fields, are moving with finite speed (according to the Theory of Relativity as well as the Theory of Electrodynamics), but none of them can ever move with infinite speed.

Let us take into consideration two electrical charges q_1 , q_2 , being located at the positions $\vec{x}_1$, $\vec{x}_2$, having the velocities $\vec{v}_1$, $\vec{v}_2$. Coulomb's law (equation (0)) is the classical approximation, not taking into account the velocities $\vec{v}_1$, $\vec{v}_2$, and not taking into account the speed of propagation of the Coulomb-field. Although their motions do exist (without any doubt), Coulomb's approximation does not have a look onto these motions. This is the reason, why it is to be regarded as a static approximation.

The reason, why these finite velocities and the finite propagation speed of the field lead to measurable consequences, is explained in [Tur 10a] und [Tur 10b]. This leads to an amendment in Coulomb's law, which converges down to ZERO for $\vec{v}_1$, $\vec{v}_2$ going down to ZERO. But if $\vec{v}_1$, $\vec{v}_2$ is not going down to ZERO, the amendment is also not going down to ZERO. And – this is the crucial consequence: The amendment can only be explained, if another (invisible) type of energy is being taken into account, additionally to the potential energy of the Coulomb-field – as will be explained on the following pages.

With other words: The classical Coulomb's law (equation (0)) can be understood as an approximation for infinite speed of propagation of the Coulomb-field, or alternatively as an approximation for slow motion of the electrical charges, which interact with each other. Thus, the basis of the work presented here, is a generalization of Coulomb's law, regarding $\vec{x}_1$ and $\vec{x}_2$ as the trajectories of the interacting partners, depending on the prehistory of the motion of the particles and of the fields, namely $\vec{x}_1 = \vec{x}_1(\vec{x}_1, \vec{v}_1, t)$ and $\vec{x}_2 = \vec{x}_2(\vec{x}_2, \vec{v}_2, t)$.

On this basis, the author presented a possible fundamental principle of tapping the zero-point-energy in [Tur 10a] and [Tur 10b], which is centrally based on the finite propagation speed of the interacting fields (FPSIF). In agreement with the Theory of Relativity and with the Theory of Electrodynamics, this FPSIF-theory postulates the very plausible assumption, that the fundamental fields of all fundamental

interactions of nature (gravitation, electromagnetic interaction, strong interaction, weak interaction), propagate with finite speed, but not with infinite speed. If it would be different, electrostatic as well as magnetic fields could be utilized to transport information with infinite speed, which is of course impossible by principle.

Because this FPSIF-principle can be utilized for the conversion of zero-point-energy by principle, it is possible to develop and construct arbitrary types of ZPE-converters on its fundament. This enables us, in the further course of the present paper, to develop an especially easy-going ZPE-converter, namely a pure ZPE-magnetic-motor (which will be called "MMDR"), driven completely by ZPE-energy, not needing any input of classical energy.

In order to illustrate the fundamental principle, according to which such ZPE-converters can be developed, the author presented a computation-example in [Tur 10c], with which he showed, how to develop a small ZPE-converter (in the range of picoWatts, nanoWatts or microWatts). The theory was traced back to the FPSIF-principle. In [Tur 11a] and [Tur 11b], a further computation-example is following, describing a powerful ZPE-motor (in the range of kiloWatts or MegaWatts), which got the name of "EMDR", the "Electromagnetic-Mechanic Double-resonance Converter", because an electro-magnetic-interaction has to be brought into resonance, in accordance with a mechanical resonance, and both resonances have to be adjusted to the speed of propagation of the magnetic field.

The problem is, that the author did not include the FPSIF - finite speed of propagation of the interacting fields, explicitly into the (former) computer simulations of the EMDR-converter, so that the question remains open, whether this finite propagation-speed is included implicitly in the responsible laws of physics or not, these are Biot-Savart's law, the Lorentz-force, and the law of electrical induction, and some others…). In the case, that the finite propagation-speed is included implicitly, the 2011-version of the EMDR would run properly, but in the case if the FPSIF-principle is not included implicitly, the computation should be completed, by additionally introducing this FPSIF-principle (with regard of the finite speed of propagation of the magnetic field) into the computation-algorithm. The consequence would be a dramatic renewal of the design, which is necessary to make the EMDR run by ZPE-energy. This design renewal can only be computed, as soon as we take the FPSIF-principle ***explicitly*** into account inside the algorithm - and this is exactly, what the present paper demonstrates.

Clear is, that it could be imaginable by principle, that the finite propagation speed of the fields, is included in the fundamental laws of physics, because we observed this exactly with Coulomb's force as can be seen in [Tur 08], [Tur 09a], [Tur 09b]. This was proven and verified by the author in the years before with his electrostatic rotor. This experience encouraged the author, to develop the EMDR without explicitly taking the FPSIF-principle into the algorithm.

But: The theoretical survey of the MMDR-construction, by now taking the FPSIF-principle into account, shows us, that the EMDR-converter absolutely needs the explicite computation on the basis of the FPSIF-principle – and then it will work properly ! This will be demonstrated on the following pages, closing former holes in theory – which makes now clear, that the new MMDR will work, but the angular velocity is much larger, than it was expected before, without taking the FPSIF-principle explicitly into account.

The computer simulation of my Magdeburg's electrostatic-rotor was possible without taking FPSIF-principle explicitly into account, because its working principle was based on the flux of the field's energy. This made its computation possible with a commercial FEM-algorithm (ANSYS). This gave a very strong expectation, from the very beginning of the theoretical development, that the rotor will spin in the laboratory - and this is, what happened.

In principle it could be tried in the laboratory, whether the EMDR and/or the MMDR would also run, with theory taking the FPSIF-principle only implicitly into account, but an examination of theory is much easier, more efficient, and less expensive, than performing the experiment. Thus I decided, to check the problem theoretically, also because I do not have a laboratory now: I added the FPSIF-principle into the algorithm, I received new results, different from the old ones, now without any doubts of implicite considerations. This means, that the results obtained now, are for sure complete, because they contain the considerations of the FPSIF-principle explicitly, making the logical structure of the physical fundament of the ZPE-magnet-motor complete. This is the result of the work presented here and now.

It is obvious, that this is an advanced development, based on the old computer-simulations of the EMDR-converter, but it has the additional advantage, that the author managed to make the working principle of the converter much more easy and efficient than before, so that the EMDR is replaced by a MMDR, needing only permanent magnets interacting with each other, renouncing from capacitors and coils (and even wires), and thus renouncing from electrical losses in connection with such elements. This makes computation easier, same as constructing and building a practical setup.

The very clearly arranged MMDR-converter is presented the very first time in the preceding paper. Only magnets have to attract and to repulse other magnets – that's all. Because all magnetic forces inside the MMDR are originating from permanent magnets, we need no classical power-supply. All we need, are rotating magnets, and an electronically controlled retarder-system, which has avoid that the magnets come into danger to rotate too fast. The setup should be easy enough now for practical realization.

By the way, it would be absolutely no problem, to include the FPSIF-principle additionally into the old computations of EMDR-simulation, and the system would work as well (with the new value of angular rotation, and the other system parameters being adjusted), but it is not necessary to take the effort for such a EMDR-system any further, because the MMDR-principle is much easier. Nevertheless it has to be mentioned, that the EMDR must run much faster then said in former publications, because the explicite consideration of the FPSIF-principle, requires a very high speed of motion of the interacting partners.

Fortunately, our MMDR-computer-simulation leads us to an engine, with conditions for an operation, which is technically advantageous, so that we can directly build a prototype with some Kilowatts of engine-power. The dimensions of such an engine are absolutely realizable, so that it is sensible now, to display the results of MMDR-computer-simulation.

The only disadvantage: We will see, that the angular velocity (the number of revolutions per minute) is much larger than considered before (without the FPSIF-principle), so that we will have to solve a task of a high-speed bearing with low friction. Important for the FPSIF-principle is the translation-velocity of the magnets, thus the velocity has to be enhanced as much as possible. This can be done in two ways, namely via enhancing the diameter of the engine (which is the diameter of the rotation) and via enhancing the angular velocity of the rotation.

With other words: The EMDR as published up to now converts ZPE-energy, but not with a power of some Kilowatts but only with a power of some hundred MilliWatts, when we make it run with 30.000 rpm as published in [Tur 11c], [Tur 11d], [Tur 11e]. The computation of the engine power of the EMDR is rather similar to the computation of the engine power of the MMDR, because the velocity of translation of the moving (rotating) magnets plays the analogous role. In order to come really into the range of Kilowatts and Megawatts, we need about 200.000-500.000 rpm and the radius of the rotor-disk containing the permanent magnets, should be about 1 Meter or even more. The technical realization should not be a problem, if we have in mind that standard turbo-chargers in automotive industry have about 250.000-300.000 rpm, and this is realized in low-cost series line-production. For instance, one of the results presented in the further course of the present paper, will be a theoretical prediction of a MMDR-ZPE-rotor, spinning at 239.000 rpm bringing a power of 18 kW, or optionally bringing a power of even 72 kiloWatts at 477.000 rpm. If the rotor can be built a little bit larger an faster, the engine can be brought into the megawatt-range without too much effort.

This means, that the "project EMDR" can be brought into operation by principle, but it is easier in reality to replace it by the "project MMDR" – and the dimensions as well as the velocity of the magnets will be about the same for both projects. But for both cases, the new algorithm presented here, teaches us, that a realistic practicable setup of a ZPE-magnetmotor, must run faster by about 2…3 orders of magnitude in comparison with the old publications of [Tur 11a] and [Tur 11b]. In this sense, the old publications of [Tur 11a] and [Tur 11b] have to be regarded as incomplete, due to the missing explicite consideration of the FPSIF-theory.

From this new knowledge, it is no longer necessary to build up the 2011-design of the EMDR, but it is preferable to build up the new 2013-design of the MMDR, because the latter one is now clear without any open questions, and without any logical gap. This means, that the computer-simulation of the ZPE-magnetmotor is now ***complete*** for the very first time. Up to now, I always emphasized, that the EMDR-

converter can be built up only after very detailed analysis by measurements in laboratory, which will be necessary for a completion of theory, but with the paper presented here, this completion of theory is done, so that the constraints of the 2011-EMDR design is not valid for the new MMDR-design given here.

This progress in the development of theory, minimizes the costs and efforts for the development of the very first prototype (of a magnetic ZPE-motor) drastically. I do not want to indicate with these words, that measurements are not necessary any further for the MMDR, but the measurements will be much easier, compared to old plans of 2011, because the construction is now theoretically secure on the basis of the explicite consideration of the FPSIF-principle, so that we can clearly predict, what we expect from the first prototype.

2. Basic Concept for the setup of a MMDR-Converter

In order to develop a computer-simulation of a ZPE-converter, we have to develop a mechanical setup first, which is capable, to convert ZPE-energy into classical energy under proper operation. This is the presumption for any computer-simulation.

If we want to build up a magnetic motor for instance, we have to bring magnets into motion; an if this magnetic motor shall be driven by the zero-point-energy of quantum-theory, the magnets have to run with a speed, which is a serious percentage of the propagation-speed of the magnetic fields, which should be the speed of light. Only if the engine fulfills this criterion, the FPSIF-principle can be utilized (as illustrated in [Tur 10d], namely in Fig.3 and Fig.4 of this paper from 2010).

From the paper [Tur 10d], we learn (among other facts), that magnets which run towards each other (approaching to each other, decreasing their distance rapidly) feel less magnetic forces (due to the finite speed of propagation of the fields), compared to the static approximation at which the magnets are at the same distance, but in rest relatively to each other. In the opposite way, magnets who have a relative motion away from each other (increasing their distance rapidly), experience stronger magnetic forces, than they would do according to the static consideration, without taking the motion of the magnets and the fields into account. This gives us the possibility to build up a construction according to Fig.1 and Fig.2, which can act as the ZPE-magnetic motor, as soon as the motion of the magnets is (extremely) fast enough. The illustration in Fig.1 can be understood as following: In part (A), the two magnets move towards each other, experiencing a repulsive force between Northpole and Northpole, leading to a deceleration of the velocity, relatively to each other. Important is the fact, that the force responsible for the deceleration, is smaller than it would be in the static consideration, namely because of the FPSIF-theory. This is also the case in part (B). The arrows marked at the magnets, illustrate their vectors of velocity (in red colour) and their vectors of the magnetic force (in blue colour). In part (A) and (B), the magnetic forces decelerate the motion, as we see they act against the vectors of velocity. This means, that the magnet on the right side, experiences a force to the right side, and the magnet on the left side, experiences a force with a direction to the left side, because Northpole and Northpole cause repulsive forces to each other.

Continuing our observation of the magnets' trajectories, we will next come to position (C), when the magnets come most close to each other, passing each other. At this position, the magnetic force alters its direction, so that it is clear that it must pass ZERO at some point. The fact, that the magnetic force changes its direction, can be seen from the fact, that in position (D), the magnetic force indicates into the opposite direction than in position (C). This means, that at part (D), where the magnet no. 2 is now located left from magnet no.1, the magnets experience repulsive forces from each other. The consequence is, that from the moment on, from which the magnets had passed each other, they accelerate each other, due to their repulsive forces. Following to the FPSIF-principle, the magnetic forces are enhanced with regard to the static point of few, so that the repulsive accelerating magnetic-forces from (C) to (D) to (E) are stronger than the repulsive decelerating magnetic-forces from (A) to (B) to (C), as a consequence of the FPSIF-principle. This is illustrated easy understandable in the video [Tur 13].

With regard to the law of energy conservation, this has the following consequence:

The mere static consideration, which is the approximation with infinite speed of propagation of the fields (i.e. without FPSIF-principle) complies with the conservation of classical energy, according to the conservative potential of classical electric, magnetic and electromagnetic forces. The dynamic consideration, taking the finite speed of propagation of the fields into account (i.e. with FPSIF-principle), requires the ZPE-energy of the quantum-vacuum being taken into regard, within the law of energy conservation. (The fundamental reason is traced back by the author, down to quantum-electrodynamics, in some of his former publications.) This means, that the sum of classical kinetic energy of the motion plus classical potential energy of the magnetic field plus ZPE-energy being converted, is constant, with the additional remark that ZPE-energy is being converted permanently from magnet-passage to magnet-passage. During the phase of deceleration of both magnets (when they approach to each other), the magnetic force is reduced, because of the high speed of the motion of the magnets, due to FPSIF-principle (relatively to the classical consideration), and during the phase of acceleration of both magnets, the accelerating force is enhanced, due to the same reasons. And the crucial point is, that the enhancement of (kinetic) energy (during the phase of acceleration) is larger than the reduction of (kinetic) energy (during the phase of deceleration). Finally, the speed of the magnets grows permanently from magnet-passage to magnet-passage (being compared at positions with the same distance between the magnets and thus the same potential energy).

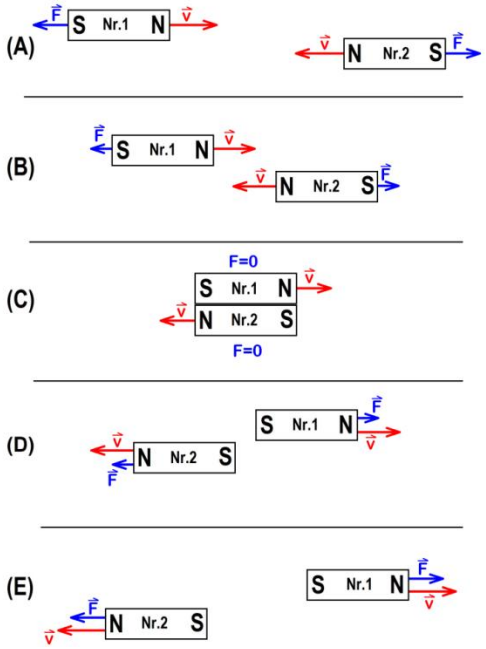


Fig. 1

Illustration of one magnet-passage, at which two magnets pass each other, so that their centres of mass have the same distance at the beginning (A) as at the end of the passage (E).

The system consisting of two magnets, passing each other, can convert zero-point-energy, if their velocity relatively to each other is large enough, to reach a serious percentage of the propagation speed of the magnetic field.

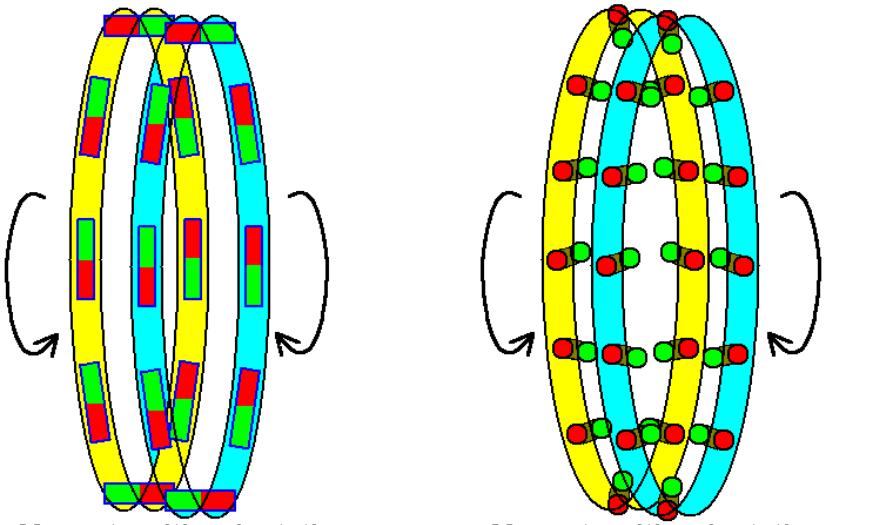
In the image, the vectors of the magnetic force are drawn in blue colour and the vectors of the velocity are drawn in red colour. The length of the arrows, symbolizing the vectors, represents the magnitude of the vectors.

Of course, two magnets which simply pass each other, do not form a functioning engine, as we can use it as a motor for technical energy-conversion with enduring working-time. In order to provide the possibility, that the engine can run for indefinite time, the engine must be built with a mode of operation, coming back to the same point periodically from time to time. This can be an oscillation or a cyclic motion as well. Such a type of motion and operation is convenient for our construction, because it can be realized within the usual methods of techniques and manufacturing. Due to this reason, the both magnets of Fig.2 (or magnet-arrays, consisting of several magnets) can be mounted within a rotating disk, where the bodies of the disks which keep the magnets (or magnet arrays), must not be permanent magnetic (for instance not ferromagnetic) and not electrically conductive (in order to avoid eddy current losses), so that the magnets can follow their trajectories without troublesome influences originating from the disks. In order to maximize the power-output of the engine, the disk with the magnets (the magnet array) shall contain as many magnets as sensible.

For the relative speed of the magnets moving towards each other must be as large as possible (this speed has to be seen as a relation of the speed of light, according to the FPSIP-principle), the number of revolutions per minute (the angular velocity) of the magnetic disks must be as large as possible, namely much larger than written in preliminary publications about the EMDR-generator. Therefore it might

probably be helpful, if we do not fix one rotating magnet-disk rigidly and make the other one spinning with the angular velocity ω, but it might be better to make both disks rotate with $\omega/2$ in direction opposite to each other. Finally it will be the task of technical mechanics, to decide whether it is better to make one disk rotate with the full speed, or to make two disks, each one rotate with half of the full speed. In the first case, the full power has to be extracted from this one disk, which is rotating with the full speed. In the second case the power has to be extracted from both rotating disks, namely half of the full power from each of the disks. The first case has the advantage of a more easy control of the angular velocity, but the disadvantage that the angular velocity is larger than in the second case. So if the control of the angular velocity can be done adequately in the second case, the second case would be preferable, but if the control of the angular velocity would be too difficult, the first case would be preferable.

From the point of the FPSIF-principle, explaining the conversion of the zero-point-energy, the crucial dimension is the speed of the magnets relatively to each other. We will now come in the sections 2.1 and 2.2, to general explanations about the Pascal-algorithm and the computer-simulation of the MMDR-converter, and in section 2.3, we will tend our attention to the considerations, how we come away from the linear motion of translation, to the rotation of the magnets.



Magnets with orientation parallel to the direction of the velocity-vector

Magnets with orientation perpendicular to the direction of the velocity-vector

Fig. 2

Practical setup of two rotating disks, which can be used as ZPE-converters, following the FPSIF-theory of the finite propagation speed of the (magnetic) field. The crucial point is, that the magnets have to be in motion extremely fast, in order to get the possibility to insert ZPE-energy into the interaction.

2.1 Symmetry of the Setup

The setup can be seen with mirror-symmetry to the origin of coordinates (see Fig.1), so that one trajectory (of one magnet) is representative for both trajectories (of both magnets). This allows us to minimize the effort of the data-storage, necessary for the description of the trajectories of the magnets, within the computer algorithm, because we only have two store the data of one trajectory, representing both of them. Finally both trajectories of the two magnets differ only in the algebraic sign from each other. We see this in figure 3, which illustrates the position-coordinates of the two magnets along the x-direction, where the magnets are running along the x-axis. The mass-centres of the both magnets are located at the positions $r = \pm X$, so that the ends of the magnets are located at the positions $r = \pm X \pm \frac{L}{2}$ – and they do this with mirror-symmetry to the origin of coordinates. For we do not have any influences, which might cause any deviation from this symmetry, the mirror-symmetry with regard to the origin of coordinates is kept during the full time of computer-simulation.

For the sake of efficiency, the magnetic-force between the both permanent magnets is determined directly from the distance of these magnets, which is $\Delta r = 2X$. (The law for the computation of the force is explained in more detail in section 3.1.)

The situation as illustrated in Fig. 3 corresponds with the time according to part (A) of Fig.1. In the same amount as magnet number 1 runs to the right side, magnet number 2 runs to the left side, so that the vector of velocity v_1 is positive (oriented to the right side) during the whole time-interval of the consideration, and the vector of velocity v_2 is negative (oriented to the left side) during the whole time-interval of the consideration, which is the durance of one complete magnet-passage (as far as being under consideration). Oppositely to the direction of the velocity, the vectors of the repulsive magnetic force and with them, the vectors of the acceleration, are directed to the left side for magnet number 1 (this is F_1 und a_1) during the phase of $X>0$, but they are directed to the right side for magnet number 2 (this is F_2 und a_2) during the phase of $X>0$; so we can say F_2=-F_1 and a_2=-a_1. (Because of the dimensionality of the system, which is **1**, the vectors have been written without arrows on top.) This is this part of the motion, which we see in Fig. 1 beginning at part (A) and following the trajectory up to part (C). At (C) the both magnets come most close to each other, and most close to the origin of coordinates, so that the part of the trajectories, which is following after (C) and then going further on, up to (D) and (E), has the opposite algebraic sign then the first part of the motion up to (C). This means, that at the second part of the motion (which is $X<0$), we observe the magnetic force F_1 and acceleration a_1 of the magnet number 1 with their directions to the right side; and the magnetic force F_2 acting onto magnet number 2 has its direction to the left side. The symmetry is still existing, so that we have F_2=-F_1 and a_2=-a_1. The consequence is, that the both magnets decelerate each other, during the phase at which they run towards each other, but during the phase when they run away from each other, they accelerate each other. And the crucial point is, that due to the FPSIF-principle, the acceleration is larger than the deceleration.

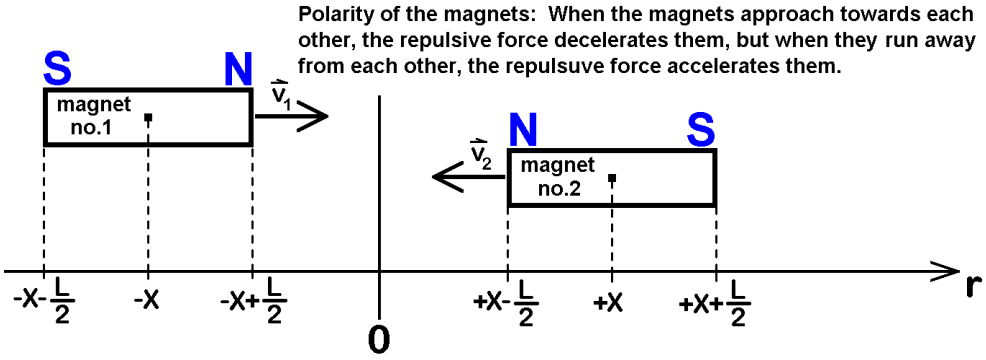


Fig. 3

Setup of the magnets with mirror symmetry with regard to the origin of coordinates.

The notation introduced here will be used from now on in our article.

2.2. General remarks regarding the programming-technique of the algorithm

A copy of the very first MMDR-computer-simulation-algorithm is printed in the appendix of the preceding paper. The appendix has the title “Source-code of the algorithm MMDR_03i“.

As a general remark, the readers shall now be informed, that during the further course of this paper, all important parts of the algorithm will be explained in the main body of the paper, using cross references to the corresponding lines in the Pascal source code. For this purpose, line numbers have been added subsequently to the source-code in red colour, in order to make the assignment between the explanation and the part within the source-code easiest recognizable.

Furthermore, it should be mentioned, that the Pascal-source-code does not ask any data interactively from the user, so that there is not any request to bring data via keyboard, via mouse or via any window into the program. All necessary parameters (and input-data) are listed in the main body of the program, beginning from line number 167, and going up to line number 200. This part of the main body of the program runs during the phase of initialization. This makes the work with the program most efficient, because it makes repeated run the program easy: When we want to change only one or very few of the parameters, from each run of the program to the next run, we do not have to enter all data again and again. The fact that the parameters are part of the phase of initialization, helps us, that we do not have

to enter the parameters every time again, when we want the program run with few alterations of some parameters.

Furthermore the efficiency of work had been optimized with regard to the data-output, by simply printing the most important results into a simple DOS-window. This allowed me to minimize the working time of the program-development, and to concentrate myself to the important aspects of physics and mathematics, which are the purpose of the computer-simulation. The output of all the results, together with an individual protocol of each simulation-run is written into an Excel-File, which gets the name of „Test.xls“ or „Versuch_nnnnn.xls“ as required by the user. The enumeration “nnnnn” is made automatically by the program. Responsible for the creation of these version-numbers (of the data-storage files), is the subroutine „Procedure Zaehlummer_lesen“ from line 51 up to line 70.

Responsible for the data-output into the Excel-file is the subroutine „Procedure ExcelAusgabe“, which is located from line 72 up to 153. The last mentioned subroutine shall be discussed now a little bit more in detail:

This subroutine is made for a data export of up to 25 columns of numerary data, of which the length is stored in the variable with the name „Spaltenlaenge“. The amount of data-columns really in use, can be of course less than 25, and its value is stored in the variable with the name „Spaltenzahl“. Because the German version of the Excel-program does not use decimal-points, but commata instead, all numerical data are formatted it in this way, appropriate for the German version of the Excel-program. This is done in the limes 113-117. All single columns are separated from each other (as Excel requires) by tabulators (see line 118).

This subroutine „Procedure ExcelAusgabe“ is being supported from the main program with a data-array named “Erg”, which contains those results of the computation, which shall be given to the Excel-file. In the example as presented in the appendix, our main program uses only 12 of the possible 25 columns of numerical data, which can be transferred via the data array “Erg”. These are the 12 data-columns as enumerated in table 1. Following after table 1, all parameters are explained.

Column	**Meaning**
A,B	Deflection and force-values defining the force-deflection characteristics of the magnet’s force of the magnet-magnet-interaction. These values are computed independently from the (later) computation of the trajectory.
C,D,E,F	Time, position, velocity and acceleration of the magnets: t_i, x_i, v_i, a_i for magnet no.1 The Index „i“ indicates the storage of the data in the program (see line 27).
G,H	TWW_{echt} und XWW_{echt} Time and position (their real values) of the interaction according to the FPSIF-theory.
I	$-x_i$ position of the „right partner“ (magnet no.2), See explanations, following after table 1.
J	$XWW_{echt} - x_i$ Difference between the field’s starting position according to the FPSIF-theory and the interaction partner position without FPSIF-theory.
K	First, and not very accurate, trial for the control of the zero-point-energy conversion, which is calculated from the alteration of the classical kinetic energy during the course of the computations (see hand-sketches: *1 on page.22) Explanations will follow later in the main body of the paper’s text.
L	Exact computation for the control of the zero-point-energy conversion, which is now calculated also from the alteration of the classical kinetic energy, but with elimination of rounding-errors (see hand-sketches: *1 on page.22). Explanations will follow later in the main body of the paper’s text.

Table 1: Contents of the Excel-columns in the data-output of the results.

Explanations with regard to table 1:

If graphical display of the results is required, this should be done for the sake of efficiency, directly in Excel, where the numerical columns can be plotted very easy with each other.

Columns A and B

The emulation of the force-deflection characteristics of the magnet's forces (line 155-165) is being developed completely independent from their later application within the solution of the differential equations for the determination of the trajectories of the magnets. This emulation of the force-deflection characteristics is a preliminary work, which is necessary, before we can start with the namely computer simulations of the trajectories of the magnets. The force-deflection characteristics of the magnet's forces are checked in the lines 202-209. The development of these characteristics is explained in section 3.1 in detail. The result of this checking-procedure, namely the force-deflection characteristics as a mathematical function, is being displayed in the Excel columns "A" and "B".

Columns C, D, E, F

These are the main central numerical values, describing the trajectories of the magnets, following a real dynamical computation, namely under control of the position-vectors and its derivatives to the time. In this aspect, of course the parameter of "time" always plays the role of the free parameter, and the position-vector and its first and second derivatives (to time) describe the trajectory, in the sense of Newtonian mechanics.

Column I

For the purpose of later evaluation and discussion of the results, it is convenient to put not only the position of magnet no.1, but also the position of magnet no.2 into the Excel-file, although they differ from each other (following the explanations of section 2.1) only by their algebraic signs, due to the mirror-symmetry with regard to the coordinate-origin.

Column J

In order to get the possibility, to estimate the real significance of the consequences of the FPSIF-theory, we will bring the difference between the "instantaneous magnet position" at the time „t_i" (in the approximation of infinitely fast propagation-speed of the magnetic field) and the real distance of interaction, as it is the distance passed by the magnetic field according to FPSIF-theory (this is the real existing finite speed of propagation of the magnetic field, in exact computation, without the uncertainty of the classical approximation of infinite propagation speed) into the Excel-file for the possibility of plotting these data later in Excel.

Columns K and L

For the purpose of later data evaluation, mainly for the evaluation of the engine-power of an individual MMDR-design, which we need for an optimum determination of an MMDR-converter-design, for each special application, the classical kinetic energy of the magnets as a function of the time, is being determined. During the phase (of the trajectory) when the magnets approach towards each other, the classical kinetic energy is of course decreasing, but from that moment on, when both magnets pass each other as well as they pass the origin of coordinates, the classical kinetic energy of the magnets is increasing. Because of the zero-point-energy conversion, the increase of the classical kinetic energy in the second part of the motion, is larger than the decrease of the classical kinetic energy in the first part of the motion.

In column „K" this increase of the classical kinetic energy has been calculated rather primitive, by comparing the actual velocity at each time t_i with the velocity at the start time t=0, which is then followed by the determination of $1/2mv^2$ in order to calculate the difference of $1/2mv^2$ at the time t_i and $1/2mv^2$ at the time t=0. In principle this type of calculation would be sensible, but the alteration of the velocity is rather small in comparison with the absolute value of the velocity (as we know, the latter one

is a realizable percentage of the vacuum speed of light), and thus, the increase of the velocity, as well as the increase of the kinetic energy following the square of the velocity, is being calculated rather uncertain ("noisy"), due to numerical rounding-errors in the software. The consequence is, that the results coming from this way of calculation is not satisfactory, because of too much numerical noise.

In order to get rid of this problem, column "L" is done by a computing the alteration of the velocity and the alteration of the classical kinetic energy, by integration the acceleration from time step to time step, summing up the velocity-alteration from step to step. This has the advantage that the real existing acceleration goes into the computation, not as the difference of large numerical values with their rounding uncertainties, but the real acceleration goes directly into the computation, so that it will not be lost any further beyond the rounding uncertainties of large numerical values. This leads us to good reliable data in column "L" for the alteration of the classical kinetic energy.

Of course, the final interpretation of the alteration of the classical kinetic energy of the magnets, in column "L" is only sensible, as long as it is compared between two positions (at the very beginning and at the very end of the magnet-passage) with the same potential energy within the magnetic field, because only in this special case, the evaluation of the potential energy of the magnetic fields is dispensable. Of course, this aspect has been taken care, namely by the examination of the classical kinetic energy at the very beginning of the magnet-passage and at the very end of the magnet-passage, at the same (identical) geometrical positions. This method is absolutely sufficient, because of the mirror symmetry of the arithmetic problem. At the beginning of the magnet-passage, we have the positions $\Delta X = |X_1 - X_2|$, with $X_1 = -X_{anf}$ and $X_2 = +X_{anf}$ („Xanf" -> see line 181 in the source-code), and at the end of the magnet-passage, we have the positions which are identical but for the opposite algebraic signs, namely $\Delta X = |X_1 - X_2|$, mit $X_1 = +X_{anf}$ und $X_2 = -X_{anf}$.

This means, that the alteration of the classical kinetic energy of the magnets following column "L" leads us to the required evaluation of the amount of mechanical power, gained from zero-point-energy, because this mechanical power results in an acceleration of the rotation. And this acceleration can be compensated by the extraction of mechanical power, for every arbitrary purpose of application.

For a permanently (long-time) running MMDR-engine, the permanently converted energy (ready for application) can be calculated, by calculating how many linear magnet passages, are being done per time during long-term rotation. This will be explained more detailed in the following section 2.3

2.3. Linear motion and rotation of the magnets

In Fig. 1 and Fig.2, we defined the guidelines for a possible mechanical setup of the system, that shall be calculated, by computer-simulation. For the sake of efficiency, it would be useless to insert many rotating magnets according to Fig.2 into our FPSIF computer-simulation, because it is sufficiently enough to perform the computation for one single pair of magnets, which represents all magnets in Fig. 1. The first pair of magnets is necessary, but all further magnets would be redundant for the computation, because they would be only a repetition of the first pair of magnets (as long as we do not put the magnets too close to each other, in order to avoid the risk, that they remarkably interfere with their over-next neighbours.)

Consequently it is sensible (in very good approximation), to perform the FPSIF-analysis for only one single pair of magnets, running linearly according to Fig. 1; and then subsequently we have to convert the results of the linear motion of one pair of magnets, into a rotation of many magnets, which finally describes the computation of the mechanical engine power of the complete rotor. For this conversion of the results, our computer algorithm needs the geometrical dimensions of the rotating disks, which carry the magnets. In principle the point is just, that we have to calculate, how many magnet-passages converting zero-point-energy, are being performed per each turn of the rotor, and per second, with regard to the complete rotor carrying all magnets.

These considerations can again be found at in the appendix “Source-code of the algorithm MMDR_03i“. Especially the data describing the rotation of the disk carrying the magnet, which are necessary for the conversion of the results from the linear motion into the behavior of the rotation of the whole rotor, can be found as following:

- The diameter of the disk is an input-parameter (see line 187), from which the radius and the circumference of the disk (line 189 and line 190) is being computed,
- The number of turns per minute (line 192) and the angular velocity of the rotation (line 191), are calculated from the input-parameter of the linear velocity of the magnets along their trajectories (line 182),
- Also the number of the magnets, which can be mounted along the circumference of the rotating disk (see line 193) is calculated automatically from some of the input-parameters, namely from the circumference of the disk, from the length of each single magnet (input-parameter from line 176), and from the length of the interspaces between the magnets (input-parameter from line 177).
- For the circumference of the rotating disk is not for sure (in all cases) a natural multiple of the length of an interspace between the magnets (input in line 177) summed up with the length of a magnet (line 177), the interspaces are adjusted in such manner, that they are equidistant with each other.
- One of the real input-parameters is also the (inertial) mass of the magnets (see line 178); but its influence onto the amount of energy being converted per each magnet-passage is rather small. Thus it does not influence the mechanical power of the ZPE-converter very much.

For the purpose of data-control, the values describing the geometrical setup of the rotating disk with the magnets, is being displayed in the lines 195-199. One of these lines is a printing command, to display the actually adjusted interspaces between the magnets, which can differ from its approximated input value (of line 177) due to the adjustment of the interspaces, as described few lines above.

Now the description of the input-data for the geometrical setup of the magnetic ZPE-motor is completed. Still to be done (perhaps by a mechanical engineer), is a strength-analysis of the material (computation of the material stress) as it is necessary to be sure, that the centrifugal-force acting on the rotating magnets is not too large, so that the rotating disks will be stable enough to withstand the high angular velocity of necessary rotation. The angular velocity of the rotation is one of the results of the FPSIF-computations regarding the ZPE-conversion, as described on the following pages. The fact, that I didn’t compute the material-strength-analysis up to now, has a rather simple reason, namely the complex geometry of the disks containing the magnets. (This computation takes an amount of time, which I can’t afford now.) But the problem has a clear background within physics: For the centrifugal-force $F = m \cdot v^2 / R$ (and together with it the material stress) decreases with an increasing radius of rotation R, so that it might appear sensible (for the sake of minimizing the material stress), to choose the disk’s radius somewhat larger than derived in the engine design following on the next pages, in order to reduce the angular velocity (keeping the velocity of translation of the magnets constant) in order to reduce the centrifugal-force. In reality, the material-stress can be adjusted to the material’s stability, by using an appropriate diameter of the rotating disk.

The computation of the real machine-power, being expected from the data of rotation, is following in the program-lines 343-346, namely after the FPSIF-computation of the trajectories. In these lines of the algorithm, the durance per each magnet-passage is being determined from the dimensions of the rotor and from the velocity of translation of the magnets along their paths. This value of the durance per each magnet-passage is the amount of time, which is necessary to convert the amount of energy, which is gained (from the quantum-vacuum) per each magnet-passage. From this amount of energy and from the amount of time necessary for its conversion, we know the machine-power of the magnetic ZPE-converter, so that the power computation is clear.

3. Real execution of the MMDR-Computations

Contents of this section, is the description of the development of the theoretical computations, which have been realized by the computer-algorithm as described in the appendix. The explanations are described as detailed as possible, so that good diploma-students or Ph.D.-students can follow them as an instruction manual in order to develop an MMDR-converter. These are just the instructions explaining, how a ZPE-magnetic-motor really works, and how it can be developed and built up - the namely instruction, for which thousands of members of the rapidly growing the ZPE-community asked me extremely often (many times per each day). Up to now I did never publish this text, in order to avoid that every person communicating with me, gets the glorious idea to make himself of herself, the inventor of MMDR-magnetic-motor.

The EMDR-converter as being described in all former publications, does not work in the design as being shown there, because the translation-velocity of the magnets is essentially too small in these publications. We see this by a putting the dimensions into the simple beginner's formula of equation (1).

$$\left.\begin{array}{ll}\text{Duration per each turn} & T=\dfrac{2\pi}{\omega}\\ \text{Distance of each circumference} & s=2\pi\cdot R\end{array}\right\} \quad\Rightarrow\quad v=\frac{s}{t}=\frac{2\pi\cdot R}{\frac{2\pi}{\omega}}=\omega\cdot R \qquad (1)$$

☹ For the parameters as published in former EMDR-designs, we see the following example:

$$v=\omega\cdot R=30000\frac{U}{\min}\bullet 10cm=30000\frac{U}{60\sec}\bullet 0.1m=50\frac{m}{\sec}\text{, this is }\ \frac{v}{c}=\frac{50\frac{m}{\sec}}{3\cdot 10^8\frac{m}{\sec}}\approx 1.67\cdot 10^{-7} \qquad (2)$$

☺ For the example published on the following pages for the first time, we see the new MMDR-design:

$$v=\omega\cdot R=300000\frac{U}{\min}\bullet 100cm=300000\frac{U}{60\sec}\bullet 1.0m=5000\frac{m}{\sec}\text{, this is }\ \frac{v}{c}=\frac{5000\frac{m}{\sec}}{3\cdot 10^8\frac{m}{\sec}}\approx 1.67\cdot 10^{-5} \qquad (3)$$

This is a comparison of the percentage of the velocity of the magnets (in motion) with regard to the speed of light (i.e. the speed of the magnetic fields), on the one hand for the elderly EMDR-publications and on the other hand for the new MMDR-publication, being introduced with the present paper.

For the power being converted from the ZPE-energy into mechanical energy, is growing roughly approximately (not exactly) with a second potential law of the translation-velocity of the magnets (according to the FPSIF-theory), we can compare the relation of power between the old (not working) design and the new (working) one, being displayed here for the very first time. Namely from

$P\approx v^2$ we derive the relation $\dfrac{P_{EMDR}}{P_{MMDR}}\approx\dfrac{v_{EMDR}^2}{v_{MMDR}^2}\approx\dfrac{1.67\cdot 10^{-7}}{1.67\cdot 10^{-5}}\approx\cdot 10^{-4}$

Thus, if the power of the (new) MMDR is in the order of magnitude about $P_{MMDR}\approx 10^4 Watt=10kW$, the "old" EMDR-design of the same size has only $P_{EMDR}\approx 1Watt$ (due to its lower angular velocity), which is much less than being printed in all further EMDR publications.

➔ The power of the EMDR, as being published in former papers, should be just even sufficient, to reduce the increase of the angular velocity, which we observe due to friction. This could lead to a scientific experiment as following: Minimize (mechanical) friction, perform a highly dynamic measurement of torque and angular velocity, bring the magnet in the EMDR to a very large angular velocity (faster than necessary for the double resonance) and observe how the angular velocity is decreasing in the course of time, due to friction. In the moment, when the angular velocity arrives at the proper values for ZPE-conversion, the decrease of the angular velocity is reduced by a small amount (see Fig.4). Probably the amount of ZPE-energy being converted, will not be large enough, to surmount friction and to keep the engine self-running. The reason is not

an error in the EMDR-concept but the reason is the much too slow angular velocity, which had been obtained (in the former publications) without taking the FPSIF-principle into account.

➔ Totally different from this, the power of the MMDR should be sufficiently enough, to achieve a stable and enduring mode of operation, which will produce enough beneficial power, not only to surmount friction (of the bearings), but also to deliver several kilowatts to the user. Actually, the MMDR will require the extraction of mechanical energy (and probably, an additional mechanical brake/retarder-system, which is actuated automatically, very fast under electronic control), in order to ensure, that the angular velocity will not increase so fast, that the material will be broken. The good operability of the MMDR-system has its reason not in any assumption, that the MMDR-concept would be somehow better than the EMDR-concept, but it has its reason in the fact that the angular velocity (as well as the translation velocity of the magnets) is fast enough, to convert enough ZPE-energy (to dirve the system completely by ZPE-energy), following the explicit computer-simulation according to the FPSIF-principle.

➔ The reason for the risk of the unregulated and quick enhancement of the angular velocity of the MMDR is the following: For the starting procedure, the magnet-rotors must be accelerated (beginning from standstill), until a value of the angular velocity is reached, at which enough ZPE-energy is converted to surmount the friction. From this moment on, the angular velocity is enhanced just by the converted ZPE-energy. This accelerates the rotation furthermore, and with it, the amount of ZPE-energy being converted, is also increasing, which has the consequence, that the rotation will be enhanced even more, which has the consequence, that the converted ZPE-energy will be enhanced even more, and so on . . . The increase of the angular velocity of the rotation, and the increase of the amount of ZPE-energy being converted, amplify each other, until finally the material will be not strong enough, to withstand the centrifugal-force, so that the material will be broken.

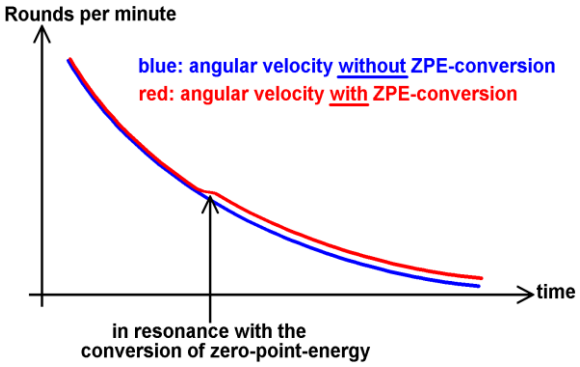


Fig.4 If the EMDR-converter, as published in the design of equation (2), is being brought to an angular velocity beyond the working- velocity, and then the angular velocity is being observed without further transmitting classical energy to the system, the rotation of the magnet(s) will get slower and slower and finally come to standstill, due to friction.

→ Without capacitor and/or without coil (this means without conversion of ZPE-energy, blue curve), the decrease of the angular velocity looks similar as the decrease of the angular velocity of a wheel without (with declutched) power unit.

→ With coil and properly adjusted capacitor, we see the moment at which the ZPE-energy is being converted (due to proper angular velocity), because at this moment the decrease of the angular velocity is reduced, due to the power being supplied from ZPE-conversion (see red curve).

It should be again emphasized, that the operability of the EMDR according to equation (2) on the one hand, and the operability of the MMDR according to equation (3) on the other hand, is not a systematic problem. We cannot say, that the EMDR would be a misconstruction, and the MMDR would be the solution of the problem, but the reality is, that both systems can work properly, as soon as the translational speed of the rotating magnet(s) reaches an appropriate percentage of the speed of light. (For the EMDR, the coil and the capacitors will have to be adjusted appropriately.) The design according to equation (2) explains to every serious scientist, who has professional working-conditions and resources, how she or he can develop a setup, converting ZPE-energy, but the explanation is not understandable to every “every hobby-imitator”. On the contrary, the design according to equation (3) has the

purpose, to develop an operable the ZPE-motor very fast, as soon as I will have my own scientific workgroup with adequate conditions.

In the reverse point of view, the conclusion is also possible (as will be seen on the next pages), that an enhancement of the angular velocity of the rotating magnet, up to the strength-limit of the material, can lead to an immense gain of power-density, same with the EMDR as with the MMDR. If it would be possible, to enhance the angular velocity to many millions of rounds per minute, it would be absolutely no problem, to enhance the power density being converted from ZPE-energy so much, that a magnetic ZPE-converter in the size of a typical refrigerator, can reach a power-output in the GigaWatt-range. Of course, this is not really possible, because the actual limit of the power density, of magnetic ZPE-motors, is defined by the stress-limit of the material, from which the engine is really built. This limit is valid in the same manner for the EMDR as for the MMDR.

3.1. The force-deflection-relation of the magnets

From classical electrodynamics, it is well known, that the force of the dipole-dipole-interaction between permanent dipole-magnets follows a $1/R^2$ – dependency (see for instance [Ber 71]). When we perform theoretical computations for a computer-simulation of a magnet-passage, this leads to the problem of infiniteness, namely the distance between the magnets will reach a point with infinitely small distance, generating the numerical nonsense of an infinitely large magnetic force. Of course, this might lead to numerical problems, as for instance a program crash like “division by zero error”, as soon as we compute the force. Obviously, values being calculated from such nonsense, can never be reliable at all, at least, because the magnetic-force in reality it not infinitely large. The problem is, that all positions of the magnets, when they come very close to each other (see C in Abb.5), lead to immense numerical noise, because even tiny small uncertainties are tiny small alterations of the magnet’s position, which will result in immense alterations of the magnetic force computed from a mere $1/R^2$ – dependency. We must find some (mathematical) mechanism, in order to avoid, that the numerical iterative computation of the acceleration, resulting from the magnetic force, is dominated by a small alteration (in the 4^{th}, 5^{th}, or even 10^{th} significant digit) of the X-positions of the magnets, which is given more or less by chance. Any numerical iterative solution of the trajectory of the magnets, must be done inevitably by discrete X-positions (as a function of time), along the trajectory of the magnet (at least because it is possible to store the trajectory only in descrete steps of X-position). In order to make these explanations understandable, we look to Fig.5 and to the explanations following after Fig.5.

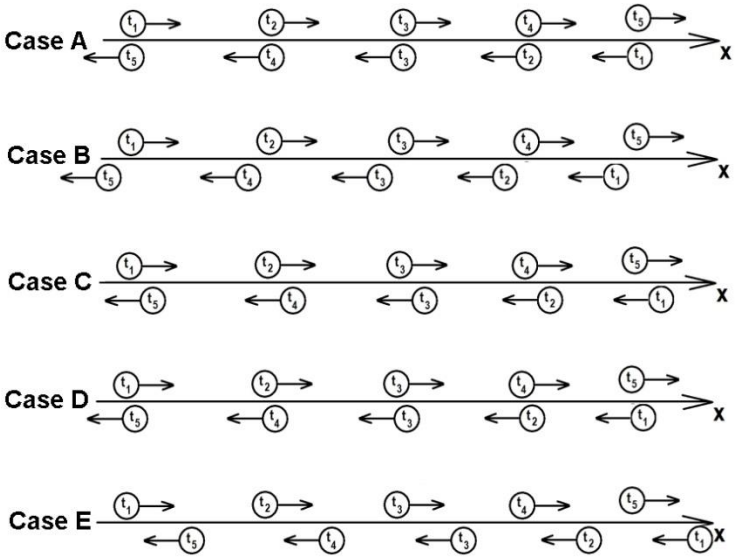


Fig.5

Real existing trajectories as being simulated with the computer, on the basis of a numerical iteration along discrete X-coordinates of the magnet’s position, which are given as a function of time.

In this example, the position of the magnet is given along the X-axis in discrete steps with the time running from t_1 to t_5.

All case considerations drawn from “A” to “E” represent only these very small sections of the complete trajectories, at which the magnets pass each other very directly, close to the origin of coordinates. This means, that all case considerations drawn here, are rather close to case (C) in Fig.1. Consequently the position of the magnet (in each discrete step), strongly depends on the prehistory of the trajectory, so it is in principle given only by chance, in which of the case considerations from “A” to “E” our system actually runs in the numeric iteration. (Detailed explanation of the cases will follow next.)

But: What we need, is a reliable computation-algorithm, which delivers deterministic results (because our system does not follow chaos-theory). Thus we have to ensure, that accidental alterations in the magnet’s position in X-direction will not lead to any remarkable influence of the results. That a mere $1/R^2$ – law cannot fulfill this criterion, and this argument can be understood most easily, when we compare the cases from “A” to “E” with each other, as we do on the following lines. They will all lead to very different results, if we would apply the mere $1/R^2$ – law:

Let us begin our case considerations (as usual) with “A”. The magnet (no.1), which is drawn above the x-axis, is moving from the right to the left side as a function of time, and the magnet (no.2) which is drawn below the x-axis, is moving into the opposite direction. At the moment t_1 , magnet no.1 is at the outermost left edge of the visible part of the motion (close to the border of the sketch), and magnet no.2 is at the outermost right end of the visible part of the sketch (close to the border of the sketch). Now, both magnets move towards each other and pass t_2 and later t_3 . At t_3 they reach their positions with the minimal distance, so that the magnetic dipole-dipole-force would reach its maximum absolute value according to the $1/R^2$ – law. But in reality, we do not have any magnetic dipole-dipole-force at the moment, when the x-distance between the magnets is ZERO, and the magnetic force does not have any direction at this moment (resp. distance), nor attractive neither repulsive. For we trace the trajectories of both magnets back, with discrete steps of a numerical iteration, the magnetic force values at t_2 and at t_4 compensate each other exactly, same as the magnetic force values at t_1 and t_5 . (This compensation is not absolutely exact, because of the consequence of the FPSIF-principle, but this consequence of the FPSIF-principle is negligible in comparison with the numerical noise discussed here – and thus the numerical noise must be avoided for sure, so that it will not make it impossible, to see the consequence of the FPSIF-principle: see below) Finally, we subsume the situation of case “A” with the result, that both magnets have the same kinetic energy at the end of the passage (at t_5) as they had at the very beginning of the passage (at t_1) – as it is shown in the sketch of the complete magnet passage.

From the fact, that the energy-balance is totally different for the other cases (“B”, “C”, “D” and “E”), we immediately recognize, that the algorithm would not be deterministic, if the magnetic force would follow the simple $1/R^2$ – law.

If we consider case “B”, the strong maximum of the magnetic force (which is reached at the moment t_3) will be computed to be repulsive, so that both magnets accelerate each other strongly at this moment. But this tremendous acceleration is not compensated by any deceleration of comparable amount, at any other discrete step of the numeric iteration. Only by chance, the small geometrical distance between the magnet’s positions at one numerical step of the iteration (i.e. step no.3), leads us to a tremendous increase of the kinetic energy, only because we apply the simple $1/R^2$ – law for the magnetic force. With untaught interpretation, somebody might come to the erroneous conclusion, that ZPE-energy would be converted, but this is definitely not proven in this case.

The opposite is happening in case “C”, where a strong maximum of the magnetic force occurs at a short distance (at the moment t_3), in the region where the magnetic force is repulsive, and thus leads us to a tremendous deceleration of the magnets. This is also a numerical artifact, due to the discrete steps of the iteration, because the deceleration does not have any antagonist, compensating the senseless strong force at one single step (i.e. step no.3) of the iteration.

With other words: We here face a numerical artifact which can juggle the conversion of ZPE-energy into classical energy, or same easy in the opposite way, the conversion of classical energy into ZPE-energy, just depending on the fact, how the magnet’s X-positions are located by chance, from discrete step to discrete step. The consequence is: If we would apply the simple $1/R^2$ – force, not only the absolute value of the result would be arbitrary, but even the algebraic sign of the result (indicating whether we gain classical energy from ZPE-energy, or whether we lose classical energy into ZPE-energy) is arbitrary. Of

course an algorithm with such tremendous uncertainty is absolutely useless. Consequently we have to reject the simple $1/R^2$ – law for the magnetic dipole-dipole-force.

The fact, that not only the algebraic sign, but also the absolute value of the result, is arbitrary as long as we use the simple $1/R^2$ – law, can be seen from the comparison of the cases „C“, „D“ and „E“ as following: In these three cases, the smallest distance of the magnets, corresponding with the maximum of force, differs very much from case to case. We see this at the moment t_3 in all three cases. In all these three cases, the magnets did yet not reach the point of the symmetry, at the origin of coordinates. This means, that in all three cases, the magnetic force is repulsive, so that it decelerates the motion of the magnets. In case “E”, this deceleration is relatively moderate, in case “D”, it is extremely large (due to the extremely small distance between the magnets at the moment t_3), and in case “C”, the absolute value of the force and deceleration, is the somewhere between the cases „D“ and „E“.

Obviously, the $1/R^2$ – force is not only nonsense from the point of view of mathematics, but it is also against the behaviour of the magnets in reality, because we never have two apply infinitely large force, when we want to bring two magnets into contact against their repulsive force, as for instance, when we bring “Northpole” and “Northpole” into contact, or in the same manner, when we bring “Southpole” and “Southpole” into contact. Infinitely large force is nonsense, from the point of physics as well as from the point of mathematics, and so we have to find a realistic R-dependency of the magnetic force, describing reality, remaining valid, when the magnets pass each other, coming extremely close to each other. This R-dependency must be found in a way, that it can be applied (as we need it) for discrete numerical steps (and not only for trajectories described analytically continuously, which we do not have, because of the data-storage of the numerical discretion of the iterative solution).

A good solution will be achieved, when we apply a cut-off radius to the $1/R^2$ – law. This is a rather typical and usual way of calculation, which is also applied to avoid problems with divergence of improper integrals. What I mean is an upper limitation to the magnetic force (-> see section 3.1), and a force different from proportionality to $1/R^2$, for absolute values of the distance, which are smaller than the cut-off radius. This way of describing the magnet-force will be very convenient later, when we determine the trajectories of the magnets, because it makes a necessary numerical interpolation of the trajectory, between the discrete steps most easy. This is a methode, to improve the precision of the numerical results, so that the convergence of the computation can be assured, with a moderate number of discrete steps of the computations, coming to a reliable result. This allows us to come to convergence of the algorithm within a sensible amount CPU-time.

Practical hints for the conduction of experiments:

For the work presented here is a pure theoretical work, the $1/R^2$ – behaviour of the force is applied for not too small distance of the magnets (i.e. for a distance beyond the cut-off radius), but for a small distance between magnets (i.e. for a distance below the cut-off radius), a polynom is inserted. This is realistic, because we do not need an infinite force, to make two magnets pass each other, as everybody can try practical very easy. For the real conduction of an experiment, we should perform real test-measurements of the force-deflection-characteristics, being obtained from two magnets passing each other, and we shall use this measuring result of the force-deflection-characteristics as a basis of the simulation of the MMDR-converter (before building the prototype). This means, that the (theoretically assumed) force-deflection-characteristics in the computer-simulation presented here, shall be replaced by the real measurement-results, as soon as it is possible from experimental investigations. This will be one of the experimental basics, which will be part of the real development of a prototype of an MMDR-converter.

The force-deflection-characteristics, as being applied in the present theoretical investigation, is displayed in Fig.6 and explained after Fig.6. When the distance (between the magnets) is beyond the cut-off radius “L”, the force is following the $1/R^2$-behavior (red and blue line). For smaller absolute values of the distance, i.e. between “+L” and “-L”, the force is connected continuously and steadily to the $1/R^2$-behavior, following a smooth transition from “+L” to “-L”. The realization of this force-model is written in

the lines 155-165 in the source-code in the appendix. Especially line 163 gives the polynomial (green line in Fig.6), of which the origination is explained after Fig.6.

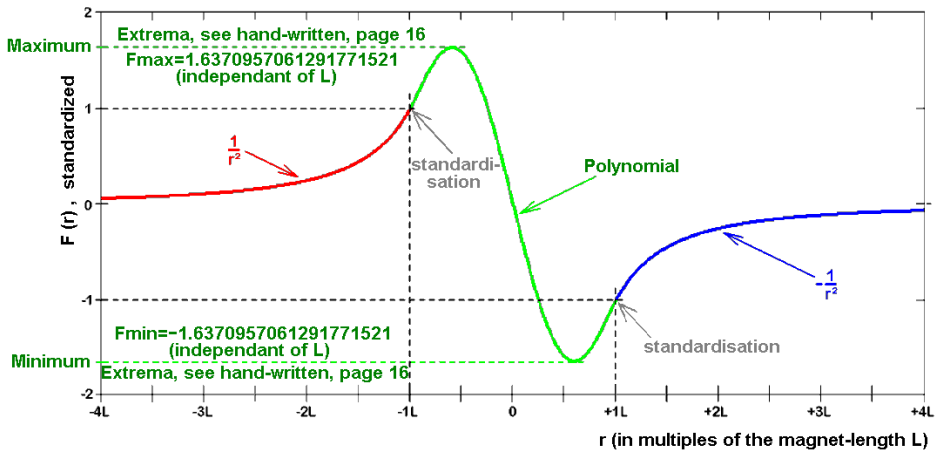


Fig.6

1/R²-force-deflection-characteristics, supplemented with a polynomial expression for distances within the cut-off radius, i.e. from "+L" to "-L". The polynomial must have a zero-crossing exactly the origin of coordinates, because at the distance of "zero", the force is also "zero".

Important for the cut-off of the pole at distance "zero" (necessary to avoid any discontinuity in the force-deflection-characteristics) is, that we avoid any unsteadiness perfectly, not only for the force $F(r)$, but also for the derivatives of the force with respect to the distance r, for as many derivatives as sensibly possible with justifiable effort. In the algorithm as presented here, this is realized according to the following explanations:

Explanation to Fig.6:

- The algebraic sign of the distance "r" corresponds directly with the positions „A" … „E" in Fig.1.
  - If the distance „r" is positive, magnet no.1 is on the left side, corresponding to the positions "A" and "B". The force, accelerating magnet no.1 acts as a vector with its direction to the left, this is the orientation against the positive x-axis, and thus the force is being regarded negative in this case.
  - When the distance "r" has its transition through "zero" (see position „C" in Fig.1), the force also must have its transition through "zero", because at a negative distance "r", the magnet no.1 is located (and running) on the right side (see positions „D" and „E"), which makes the repulsive magnetic force acting onto magnet no.1, being a positively accelerating force, with its orientation into the direction of the positive x-axis.

- From practical observations, it is normally well known, that the magnetic force comes to its maximum, when the magnet-poles come most close to each other, similar as is shown in Fig.7. To experience this experimentally, it is only necessary, to bring two magnets next each other, as shown in Fig.7. The distance of the mass-centres of the both magnets (being symmetrically) is a little bit smaller than the length "L" of each magnet in these positions. Due to this reason, I decided to fix the cut-off radius for the 1/r²-law at $r=\pm L$ (standardization to F=1 at $r=\pm L$ in Fig.6), and to use the range in between $r=\pm L$ (this is $-L<r<+L$) for the transition from the positive part of the hyperbola to the negative part of the hyperbola (of the the 1/r²-curve). The transition is performed with a continuous polynomial. The maximum of the magnetic force is being located within the range of this polynomial, printed in green colour in Fig.6. The (symmetric) absolute values of this maximum is F_{min} und F_{max}, which are independent of the scaling of the abscissa in the standardized version of Fig.6, and they will be used later for the calibration of the ordinate, representing the magnetic force.

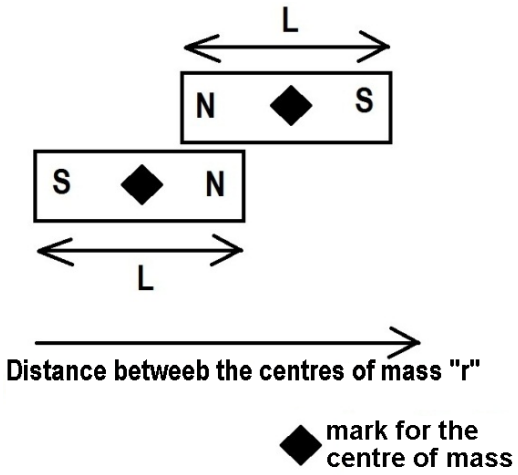


Fig.7
Illustration how to find the maximum of the force between two magnets, as it can be understood by simply holding the magnets next each other.
The polarity as shown in the figure, is consistent with the setup of the MMDR-converter, but when the reader tries to find such position of the force-maximum by herself/himself, it is most easy if she/he turns one of the magnets to the opposite orientation, in order to make the force attractive.

Because of the mirror-symmetry of the whole physical setup, with regard to the origin of coordinates, the polynomial $p(r)$ should be an uneven function in mathematical sense, so that it fulfills the condition $-p(r)=p(-r)$, but we also want to verify this, and thus we begin our development of the polynomial $p(r)$ of the degree "N", with the general approach according to (4):

$$p(r)=\sum_{\nu=0}^{N} a_\nu r^\nu \tag{4}$$

When we claim, that the polynomial and the hyperbolas are adjusted to each other, at the points $r=\pm L$, to be identically in their values, in their first derivatives and in their second derivatives with respect to "r", we get three conditions for each of the (both) changeover-points. Thus we have ***six*** conditions, allowing us to determine ***six*** coefficients for the polynomial. Consequently we can work with a polynomial of ***5th*** degree (N=5) and count $\nu=0\ldots5$ in equation (4).

Of course, it would be possible to adjust more higher derivatives, and by this means to adjust polynomials with even higher degree (this could by principle be raised as much as we like), but when we see the result of a polynomial of ***5th*** degree, will recognize, that the degree of five is absolutely sufficient, and every additional effort, to get more higher degrees of the polynomial, would not be necessary. Thus, I decided to work with a polynomial of the 5th degree and its first and second derivative, as shown in equation (5). These values of the polynomial and its derivatives are compared with the values of the $1/r^2$-law as shown in equation (6). From this comparison, we come to the conditions and the determination of the polynomial coefficients according to equation (7 a…f).

$$\begin{aligned} & p(r)=a_5r^5+a_4r^4+a_3r^3+a_2r^2+a_1r^1+a_0r^0 \\ \Rightarrow \text{First derivative to time:}\quad & p'(r)=5a_5r^4+4a_4r^3+3a_3r^2+2a_2r+a_1 \\ \Rightarrow \text{Second derivative to time:}\quad & p''(r)=20a_5r^3+12a_4r^2+6a_3r+2a_2 \end{aligned} \tag{5}$$

These values of the polynomial and its derivatives have to be adjusted to the values of the $1/r^2$-law. The $1/r^2$-law is written in equation (6), and the adjustment is written in the equations (7 a…f).

$$\text{Force-law}\qquad f(r)=\begin{cases} -r^{-2} & for\ r=positive \\ +r^{-2} & for\ r=negative \end{cases} \tag{6a}$$

$$\Rightarrow \text{First derivative:}\qquad f'(r)=\begin{cases} +2r^{-3} & for\ r=positive \\ -2r^{-3} & for\ r=negative \end{cases} \tag{6b}$$

$$\Rightarrow \text{Second derivative:}\qquad f''(r)=\begin{cases} -6r^{-4} & for\ r=positive \\ +6r^{-4} & for\ r=negative \end{cases} \tag{6c}$$

The determination of the polynomial coefficients is traced back (as already explained) to the equity of (5) and (6) at the positions of the transition at $r = \pm L$. These are six conditions leading us to the six equations of (7 a…f). I still want to mention the standardization of function $f(r = \pm 1) = 1$, because for the adjustment of the polynomials to the hyperbolas (i.e. for the determination of the polynomial coefficients), it is not necessary to take any further factors of proportionality into account. Such further factors of proportionality will be necessary, when we will later calibrate the whole couple of standardized functions to the real amplitudes of the magnetic force, and to the real length of the magnets, as being achieved by real existing magnets.

$$p(-1) = f(-1) = +1 \quad \Rightarrow \quad a_5 \cdot (-1)^5 + a_4 \cdot (-1)^4 + a_3 \cdot (-1)^3 + a_2 \cdot (-1)^2 + a_1 \cdot (-1)^1 + a_0 = +1 \tag{7a}$$

$$p(+1) = f(+1) = -1 \quad \Rightarrow \quad a_5 \cdot (+1)^5 + a_4 \cdot (+1)^4 + a_3 \cdot (+1)^3 + a_2 \cdot (+1)^2 + a_1 \cdot (+1)^1 + a_0 = -1 \tag{7b}$$

$$p'(-1) = f'(-1) = +2 \quad \Rightarrow \quad 5a_5 \cdot (-1)^4 + 4a_4 \cdot (-1)^3 + 3a_3 \cdot (-1)^2 + 2a_2(-1) + a_1 = +2 \tag{7c}$$

$$p'(+1) = f'(+1) = +2 \quad \Rightarrow \quad 5a_5 \cdot (+1)^4 + 4a_4 \cdot (+1)^3 + 3a_3 \cdot (+1)^2 + 2a_2(+1) + a_1 = +2 \tag{7d}$$

$$p''(-1) = f''(-1) = -6 \quad \Rightarrow \quad 20a_5 \cdot (-1)^3 + 12a_4 \cdot (-1)^2 + 6a_3 \cdot (-1) + 2a_2 = -6 \tag{7e}$$

$$p''(+1) = f''(+1) = +6 \quad \Rightarrow \quad 20a_5 \cdot (+1)^3 + 12a_4 \cdot (+1)^2 + 6a_3 \cdot (+1) + 2a_2 = +6 \tag{7f}$$

These six equations can be solved with the use of a Gauss-Jordan-algorithm in order to determine the six polynomial coefficients:

$$a_5 = \frac{15}{8};\ a_4 = 0;\ a_3 = -\frac{21}{4};\ a_2 = 0;\ a_1 = \frac{35}{8};\ a_0 = 0 \quad \Rightarrow \quad p(r) = \frac{15}{8}r^5 - \frac{21}{4}r^3 + \frac{35}{8}r \tag{8}$$

The mathematical uneven symmetry of the function, which we use as cut-off polynomial, is confirmed indeed. So, in principle our polynomial is ready for application now.

What we still need, is the scaling of the abscissa and of the ordinate, in order to convert the standardized equations (6) and (7) according to $f(r = \pm 1) = 1$ to arbitrary length (abscissa) and to arbitrary magnetic force (ordinate), which is in principle just a re-scaling procedure of the standardized functions:

● The re-scaling of the free parameter („r“) along the abscissa, has the purpose to adjust the length-scale for the position and the length of the magnets, to any real existing setup, for which we want to develop the layout. Therefore, we just have to divide the „r“ by „L“ within the argument of the polynomial – as it is usual in such cases – this is completely sufficient.

● The re-scaling of the magnetic force-scale along the ordinate is being determined on the basis of the positive and the negative extremum-values of the force; this is the maximum of the positive force and the minimum of the negative force in Fig.6 (which both have identical absolute values). Because the polynomial has the 5th degree, I did this for the sake of simplicity with a numerical iterative method (available automatically at my computer with an algebra-software), leading to the result of:

$$P_{max} = 1.6370957061291771521$$

This is the maximum of the standardized polynomial, to which line 179 in the source-code of the program is referring. The value is originating from the algebra-software Math-Cad, and I inserted the value into the MMDR-simulation just as a numerical value. The force scaling of the ordinate is then made as a multiple of P_{max}. If we for instance have a holding-force of the magnet of F_{max} = 80 Newtons (see line 180 in the source-code), the values of the standardized polynomial $p(x)$ have to be multiplied with $\frac{F_{max}}{P_{max}}$, so that the force-maximum really reaches the value of the holding-force of F_{max} (see line 164 in the source-code).

When introducing both scaling procedures (along the abscissa and along the ordinate) into the force-deflection-characteristic (curve), I got the force-law of equation (9) and Fig.8 as being used in the algorithm for the computer-simulation of the MMDR-converter.

$$F(r)=\begin{cases}\dfrac{F_{\max}}{P_{\max}}\bullet\dfrac{1}{\left(\frac{r}{L}\right)^2}\bullet(-\mathrm{sgn}(r)) & \text{für } |r|\geq L \\ \dfrac{F_{\max}}{P_{\max}}\bullet\left(\dfrac{15}{8}\left(\dfrac{r}{L}\right)^5-\dfrac{21}{4}\left(\dfrac{r}{L}\right)^3+\dfrac{35}{8}\left(\dfrac{r}{L}\right)\right) & \text{für } |r|\leq L\end{cases} \tag{9}$$

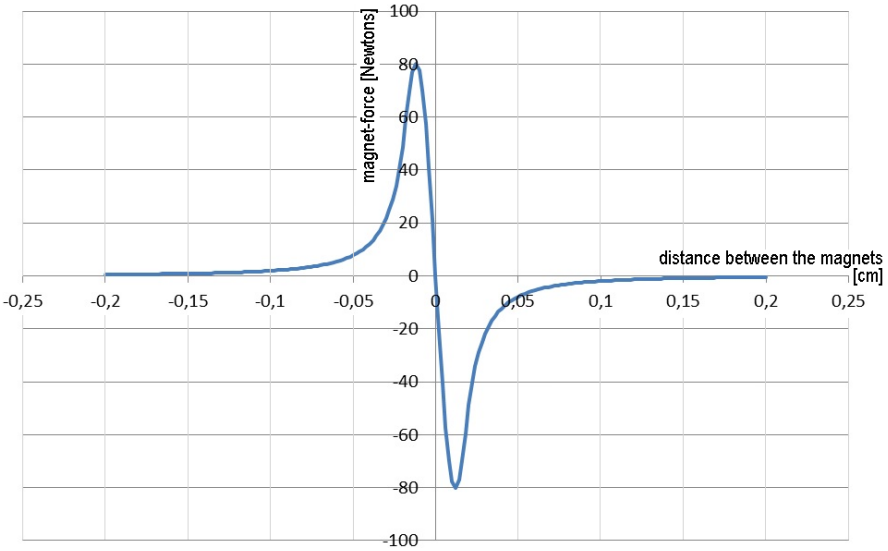


Fig.8

Example for the emulation of a force-deflection characteristic line, which shall describe the interaction between two magnets with a holding force of 80 Newtons and a length of 4 cm per each magnet.

The force-deflection characteristic is verified in the source-code in the lines 202…209, namely by plotting the force as a function of the deflection, by repeatedly calling the force-deflection subroutine (line 155), giving the whole range of distance, possible along a complete magnet-passage, into the subroutine. The results of this verification are being given to the Excel-columns “A” for the deflection and “B” for the force. The curves can be plotted in Excel, whenever the user likes to do this.

3.2. Tracing back the trajectories

Section 3.1 had only been a preparation of the computer-simulation of the MMDR-converter, but now we come to the central aspect of the FPSIF-theory, the computation of the conversion of ZPE-energy, on the basis of the finite propagation-speed of the interacting fields. In the example of magnetically operating ZPE-converters, the fields are magnetic fields, which have to carry forward the magnetic force, between the magnets interacting with each other (see [Tur 10a] and [Tur 10b]). Because of the finiteness of the velocity of the fields and the force-transmission procedure, we have to take into account the alteration of the positions of the interacting partners (the magnets), during the time, during which the interacting field is running from one partner to the other. This means, that we have to take permanently all alterations of the positions of the fields, and of positions of the magnets, continuously into account as a function of time, for our computer simulation. Only if we take all these positions (of all material and all immaterial components) and their alterations into account permanently, we can explain the conversion of zero-point-energy.

Consequently we come to the following knowledge: If we want to determine the real distance and real time-interval, which the force-transmitting fields have to pass, from one magnet (partner of interaction) to the other one, it is not sufficient to know the positions of both partners of interaction at a given moment, and to enter this distance into the force-deflection-law. In reality, for a correct computation of the force (for instance the force acting on magnet no.1), it is necessary, to determine the start-position of the field arriving at magnet no.1 now, and this start-position is the position of the interacting partner (in our case magnet no.2) being traced back (in time), to the position where it had been, when it had emanated the magnetic field (component), which arrives at magnet no.1 now. This is a long sentence, containing a complicated logical structure, but it is the main central aspect of the FPSIF-theory, and so it

is important to understand it completely, if necessary by reading additionally the explanations given in [Tur 12] (especially in section 1, Fig.1).

Because of this necessity, to trace back the position of the interacting partner, retrospectively through space ***and*** time, in order to get the possibility to apply the FPSIF-theory, all trajectories of all interacting partners have to be stored in the computer program, in order to make the requirement possible, to trace back all trajectories of all partners, at any arbitrary moment of time. Optimum desirable would be the possibility to trace back all trajectories, without any interruptions, by their mathematical functions of the position as a function of time. But in reality, we cannot get these functions analytically, because our FPSIF-simulation-algorithm is based on numerical iterations. This means that we have to store the data-set of the trajectories by the storing discrete position-time data-couples, through which the trajectories are running. Consequently, arbitrary continuous positions along the trajectories, can only be found by interpolation of the motion between the data-couples (available in the data-storage), describing the trajectories. This leads us to several numerical and mathematical necessities, as they are described in the following text:

For the solution of the differential-equations, describing the motions, it is not sufficient (as it would be sufficient for classical differential-equations describing motions in Newtonian's concept of causality, or describing motions according to Rowan Hamilton's conception), to know only the positions, the velocities, and the forces (representing accelerations) of the bodies and partners in motion, and to put these data into the adequate differential-equations. Of course, we can follow Newton's solution of the motion, by putting the acceleration into an integral, leading to an alteration of the velocity, and putting this velocity-alteration again into an integral, leading to an alteration of the position – and we have to perform this type of calculation ! But additionally to this, we now face the additional task, to derive the really applicable force, from the trajectories of the interacting fields and trajectories of the interacting partners, and this must be done by tracing back the trajectories of the field-emitting interacting-partners during all time of the motion. This is in principle an additional complication to the computation, and one of the consequences of this complication is, that Newton's "action = reactio" must be seen with some time delay between the "action" and the "reaction".

Therefore it is clear now, that the procedure of tracing back the trajectories (of the partners of interaction), is the real central novelty and innovation of my new FPSIF-principle, which makes the difference to all methods used elsewhere, up to now. Of course, this very novelty is responsible for the applicability of my FPSIF-theory, and for its capability to introduce ZPE-energy into the law of energy-conservation. Consequently, it is of main central importance now, to tend our attention very exactly to the trajectory-trace-back procedure, which begins in the source-code at line 219. We have to perform two parts of this computation, as following on the next pages.

Part 1 of the trajectory-trace-back procedure → The Extrapolation:

By principle, a fundamental problem of every trajectory-trace-back procedure is the fact, that the trajectory must start a given position at a given time. Somewhere and sometime is always the very first data-couple of our knowledge about the trajectory, and this is the very beginning of our simulation. It is impossible by principle to trace back the trajectory before the very beginning of the simulation, because the "beginning" is defined as the very first point. If we want to find the (magnetic) force (and the acceleration resulting from this force) acting on magnet no.1, at the very beginning of the simulation, which we want to denominate $t = 0$, we should trace back the trajectory up to this very position and this very time, at which the interacting partner (no.2) emitted the magnetic field, which arrives the magnet no.1 now at the moment $t = 0$. For this field was emitted at $t < 0$, we should trace back the trajectory before the very beginning of our consideration, but we do not have the complete (reliable) information about the trajectory at this time (because it is laying before the very "beginning" of our consideration).

Obviously it is impossible by principle, to know the trajectory before the very beginning of our consideration. It is useless to bring the argument here, that we could fix the very beginning of the trajectory ($t = 0$) at an earlier moment - because if we would do this, we would have the same problem at an earlier moment, so that the problem would not be solved, but only be shifted in space and time.

Actually we only have the option, to put the very beginning of the consideration to a moment, at which the distance between the interacting partners (the magnets) is so large, that we can say with very good approximation, that the force and the acceleration at this position and moment, are negligibly small. Nevertheless, if we apply this (very good) approximation, it is not recommended to treat the (magnetic) force as "zero" for $t<0$, but it is recommended, to determine the magnetic force for $t<0$ by linear extrapolation, under the assumption, that the acceleration at such small force is small enough, to trace back the trajectory under the premise of constant speed of motion of the interacting partners. The approximation, that the motion of the interacting partners is uniformly before $t=0$, is the most precise approximation, with the smallest uncertainty, we can obtain. (Alternatively we could apply constant acceleration instead of constant speed, for time $t<0$ before the "beginning", and this would be an even better approximation than mine in the algorithm, but due to the fact, that the force is extremely small, the quality-difference between both types of approximation is negligible.) This is the basis for the iteration number "zero", as can be seen in the source-code in the lines 222 … 250.

The practical realization of the iteration number "zero", based on a linear extrapolation of trajectory (to the time before its very beginning), can be understood as following (please see for illustration also Fig.9, and accept the very vivid style of the explanation):

My position (I decide to fix myself to magnet no.1) is now (at the time $t=0$) at my starting-position ($Xanf=-20cm$, data-input in line 181). My interacting partner (I decide to fix him to magnet no.2) is located now (at the time $t=0$) at his starting-position ($-Xanf=+20cm$). And then we pose the following question:

At which position (parameter „$Xecht$") was my partner located at which time (parameter „$Techt$"), when he emitted this very special component of the magnetic field, which arrives at me with my position now at the time $t=0$? Beginning from this time and this position, the partner performed his motion along his trajectory in meantime (this is from $Techt$ up to $t=0$) from his former position to his actual position now, and the field followed its motion in meantime, from the former partner position to my actual position now. This is possible, because both objects (the interacting partner on the one hand, and the field on the other hand) move with different speed. This is illustrated in Fig.9. Because the magnetic field always propagates faster (namely with the speed of light) than every interacting partner (as magnets with ponderable mass), the starting-position of the field is always behind the "starting-position" of the partner (magnet no.2) who is running from his "starting-position" towards his "now-position".

Putting the different speed of propagation, of the fields and of the partner into the formulas, we come to the following equation (10):

$$\text{run-time of the field:}\quad t_{field}=\frac{X_{echt}-X_{me,Nr.1}}{c} \tag{10a}$$

$$\text{run-time of the partner of interaction:}\quad t_{Partner}=\frac{X_{echt}-X_{Partner,Nr.2}}{v} \tag{10b}$$

X_{echt} must be determined in such way, that the propagation time for the field and for the partner will be equal, this is $t_{field}=t_{Partner}$. The extrapolation therefore is performed numerical iterative. It is located in the source-code in the lines 227 … 245. Its result is being written to the Excel file in the lines 246-250 for the purpose of documentation.

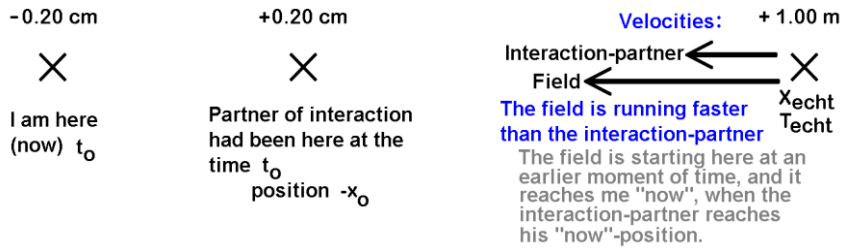


Fig.9
Illustration of the extrapolation, tracing back the trajectory of the interacting partner, down to a moment of time before the very beginning of our trajectory, at which the interacting partner emitted this very component of the field, which arrives me now at the very beginning of the computation of the trajectories.

The position-time data-couple being found by this extrapolation is „ $Xecht$ “ and „ $Techt$ “. It describes the most early trace-back time and position, being located at a time before $t=0$, which can ever occur in our consideration. Because the field, being emitted at this position and time, arrives at my position $Xanf$ now (at $t=0$), all other components of the interacting field, which reach me the later, must have been emitted later than at the time $Techt$. Thus we can regard the time $Techt$ and the position of the interacting-partner $Xecht$ at this time, as the most early position-time data-couple of the extrapolation before the beginning of our trajectories. In the trajectorie's data-array (see source-code), this position-time data-couple ($Xecht$, $Techt$) is being stored as the "minus first" point of the trajectory. This can be seen in the lines number 252-256 in the source-code. This gives us the possibility, to find always the complete trajectory from the very "pre-beginning" up to the trajectory point number "I", between the "minus first" point and the point of consideration (in the moment "now"), which has got the number "I". This makes the further development of the algorithm very efficient, because we do not need any extrapolation anymore during the complete trace-back procedure (of the trajectories). All we further need, is an interpolation between well-known points of the trajectory (from point "-1" to point "I"). In order to express this, the source-code contains a comment, referring to the backwards prolonged trajectory from point number "-1" to point number "SZ". Based on this explanation, from now on, we will perform the whole trajectory trace-back procedure, (according to the FPSIF-theory) within a well-known range of the trajectory, as can be seen in the source-code from line 258 on.

Part 2 of the trajectory-trace-back procedure → The Interpolation:

From line 258 (in the source-code) up to line 341, we find the central core of the algorithm, which simulates the operation of the MMDR-converter according to the FPSIF-theory. Because the extra-polation-part of the algorithm is done and finished, and we are already within the interpolation-part, the actual position-time point of the field-start, which is the data-couple „ $Xecht$ “ and „ $Techt$ “, is to be found at one discrete point of the trajectory (as being stored) or in between two such discrete points of the trajectory. It is extremely unlikely to find „ $Xecht$ “ directly at a given discrete point (in the data-storage) along the trajectory „ $X[I]$ “, because the equity of $Xecht = X[I]$ must be given with about 20 significant decimal digits, to get this equity. Thus we can be almost sure, that the field-start position will be found in between two discrete points of the trajectorie's discrete data-points. I assumed this for my algorithm, with the side-effect that in the case of the equity of $Xecht = X[I]$, the interpolated field-start position would be determined only with a precision of 7 significant decimal digits, laying in the 8th digit beside the discrete point of the trajectory (see line 315). (This minimal lack of precision is a negligible disadvantage.)

Consequently, we begin our determination of the field-start position „ $Xecht$ “ with the search of those both trajectory points, between which the real field-start position must be located. These are those both trajectory-points, between which the interpolation will have to be performed, as being found in the source-code from line 259 … line 278. Therefore, we trace back the trajectory of the partner no.2, by the means of its acceleration and its speed (see lines 264-268), and we trace back the field component (Repeat … Until – loop from line 271-278), until finally the runtime of the field to my position " $Xecht$ " (now), is identically the same, as the runtime of the partner, to his position now. This is again following the logical structure of Fig. 9, where the „Repeat … Until“ stands for the action (the computer-loop), to go back along the trajectory (point by point), until the explained runtime-criterion is fulfilled. This will be regarded as done, as soon as the parameter "J" is determined, which fits into the condition, that $Xecht$ is laying between $X[J]$ and $X[J+1]$ and also $Techt$ is laying between $T[J]$ and $T[J+1]$. As soon as this condition is achieved, we have found those both trajectory-points, between which $Xecht$ and $Techt$ have to be interpolated. This parameter "J" is available in the source-code, from line to 279 on.

Warning - be aware not to do the following logical error:
For the sake of minimizing the effort to develop the algorithm, you could have the idea to take $Xecht$ as the arithmetic average between $X[J]$ and $X[J+1]$, and in analogous manner to take $Techt$ as the arithmetic average between $T[J]$ and $T[J+1]$. If you then want to enhance the exactness of the

computation, you could have the idea, to refine the steps of the trajectory so long, until finally the imprecision goes down in limes to zero. This approach has been tested with the $1/r^2$-force and being rejected, because the force-divergence of Fig.5 leads into inexpugnable problems. With other words: In the phase, when the both magnets are very close to each other, you would get an $Xecht$-position by chance, and thus a very small random distance between the magnets, resulting in a very strong random force (due to the $1/r^2$-law), so that one single position-time data-point along the trajectory, plays a charade of a strong magnetic force, whereas the partner of interaction cannot compensate this force according to „actio=reactio“, because of the discrete steps of the trajectory. This would lead into a massive artifact of calculation according to Fig.5. Although it would be possible, to try whether this problem can be solved by applying a sensible force-characteristics according to Fig.8, I did not try this test, because in reality I'm not interested in artifacts of calculation. Thus I preferred (and decided) to combine the good realistic force-characteristics according to Fig.8, with a good interpolation of the trajectory between the discrete point of the data-storage, which makes the imprecision of the calculation of an arithmetic mean value obsolete.

The interpolation as explained between the both trajectory points $X[J]$ and $X[J+1]$ resp. $T[J]$ and $T[J+1]$ is being realized (from line 280 up to line 316 in the program) via a classical nested interval-computation, because the data-points number „J“ and „J+1“ can be used as the borders (to start the interpolation) of the interval without any problem:
For this purpose, we look to the left border of the interval, the right border of the interval, and to the middle of the interval, and we observe the runtime of the partner (no.2) and the runtime of the field component, in order to find out, in which half of the interval the real field-start-position and field-start-time ($Xecht$; $Techt$) is located. This half of the interval, which is found by this comparison, will be made the new interval for the next step of the iteration, which will have to be subdivided into two parts of equal wideness, and so on . . . This procedure will be repeated as often as necessary, until both borders of the interval will be close to each other with in seven decimal digits. As soon as this condition is reached, we know the real field-start-coordinates ($Xecht$; $Techt$) with a precision of seven decimal digits. This is criterion to finish each step of the interpolation, which can be found in the source-code in line 315.

Now we have got the result of the trace-back procedure of the trajectories, and this is exactly the result which we need to know the distance of interaction, namely distance from my position (magnet no.1) now, and to the position of the partner (magnet no.2) at the time, when he emitted the field component, which is arriving at my position now. (For illustration please see equation (9) and Fig.9). The corresponding computation of the force has already been explained in section 3.1, so that we now can directly come to the computation of the corresponding acceleration (by inserting the inertial mass of the magnet into the calculation) – see source-code in line 319. This is the second derivative of the position with regard to the time, from which we can come to the solution of the differential-equation of the motion, by two steps of integration (see lines 320-323).

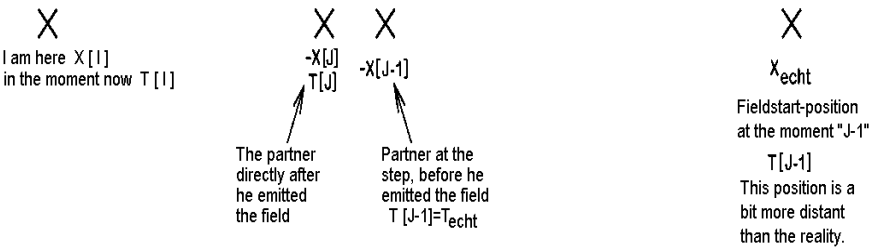


Fig.10
Illustration of the interpolation of the position of the interacting partner, at the moment of time, at which the partner emitted this very field component, which arrives at me “now” during the course of my trajectory.

In the next lines of the source-code, we find the activity to store the date of the trajectories (time „t“, position „x“, velocity „v“, and acceleration „a“) in the Excel-columns C, D, E and F (see lines 327-330), as well as the corresponding data-couples of ($Xecht$; $Techt$) in the Excel-columns G and H (see line 332).

For the convenience of data-evaluation later (with Excel), in addition to my position $X[I]$ (I am located magnet no.1), additionally also the position of my partner of interaction $-X[I]$ (magnet no.2) is the stored in the Excel-column I (see line 333). Both positions differ from each other only by their algebraic sign.

In Excel-column J, we stored the difference between the position of the interacting partner (magnet no.2) at the moment $T[I]$ and the position of the field-start at the same moment $T[I]$ (see also line 333), which is a highly interesting information, because it gives us the difference between the running-distance of the field, according to the classical approximation (with an infinitely fast field) and the exact running-distance of the field (with the propagation speed of the field as the speed of light) , according to the FPSIF-theory. This means that column "J" tells us, how effective the application of the FPSIF-theory acts (in converting ZPE-energy), due to the fast motion of the magnets. This is the important information about the deviation of the real FPSIF-force, from the classical approximation with conservation of classical energy, as it describes the limit-case of an infinitely fast propagating field, or of infinitely slow motion of the magnets. The very last mentioned limit-case fits very good to classical electro-motors, as we can find them for instance in drilling-machines (to be bought in a supermarket).

Of course, we are interested in much more than only the deviation between the real interaction-distance (according to the FPSIF-theory) in comparison with the classical approximation of the interaction-distance according to infinitely fast propagation speed of the fields. Of very essential interest is, how much energy can be converter from the quantum-vacuum (ZPE-energy) due to this deviation between the classical approximation and the exact view of FPSIF-theory. Therefore, we need to calculate the increase of the classical kinetic energy, during one complete magnet-passage. One complete magnet-passage is defined as the motion of the magnets, from one well defined distance, passing each other, to exactly the same distance at the end of the passage-motion. This definition is sensible, because the potential energy within the system, is the same at the very beginning of the passage and at the very end of the passage. (Thus we do not have to care about the potential energy.) In the example of my MMDR-design-algorithm, this means that magnet no.1 starts at the position $+X_{Anf}$, and the passage is complete, in the moment when magnet no.1 arrives at the position $-X_{Anf}$ (with negative X_{Anf}). Because of the symmetry of the problem, magnet no.2 had passed exactly the same distance, just only into the opposite direction, during one complete magnet-passage. Due to this reason (namely because the potential energy is the same at the beginning and the end of the complete magnet-passage), the alteration of the classical kinetic energy, describes also the alteration of the total classical energy, which is also the amount of energy being converted from the quantum-vacuum (ZPE-energy).

By principle, it would be possible, to trace the alteration of the kinetic energy, always as the difference of the classical kinetic energy at any arbitrary time "t", and the classical kinetic energy at the starting-time of the consideration „t=0". But in the real calculation-algorithm, this approach would lead into problems with numerical rounding and some imprecisions, originating from this numerical rounding. To understand this, we refer to equation (11), in which the alteration of the kinetic energy is computed in comparison between the kinetic energy at the speed at the very beginning of the consideration and at the speed at the arbitrary time "t".

$$\Delta E = E(t) - E_0 = \frac{1}{2} m \left[(v_0 + \Delta v)^2 - (v_0)^2 \right] = \frac{m}{2} \cdot \left[v_0^2 + 2v_0 \cdot \Delta v + \Delta v^2 - v_0^2 \right] = \frac{m}{2} \cdot \left[2v_0 \cdot \Delta v + \Delta v^2 \right] \qquad (11)$$

The problem with imprecisions of numerical rounding comes from the fact, that it is $\Delta v \ll v_0$ (the angular velocity as well as the linear velocity, only alters by a very small percentage of its total value, during one magnet message), and thus the alterations of Δv will only be noticed in decimal digits far behind the leading ones.

The solution of this problem is, that I (alternatively) traced the kinetic energy from each discrete step of computation, to the next one, along the trajectory. I traced this kinetic energy on the basis of the magnetic-force and the acceleration, with inserts kinetic energy, from each step to the next one. For we know, that energy is force, multiplied with distance (see equation (12)), we can follow the real FPSIF-force along the trajectory, and insert the distance between each trajectory-point and its neighbouring

trajectory-point into equation (12). By this means, we can record the real alteration of kinetic energy from discrete point to discrete point of the trajectory. This gives a result with good precision.

$$\Delta E = F \cdot \Delta x = m \cdot a \cdot \Delta x \tag{12}$$

For extremely high speed of the magnets "v" (along their trajectories) both types of computation of the kinetic energy (according to equation (11) and to equation (12)), lead to identical results, because the numerical rounding imprecisions will be less problematic, as long as the speed of the magnet is extremely large. This is the case, as soon as the speed of the magnets, reaches several percent of the vacuum speed of light, or even more. But if we decrease the speed of the magnets, down to realistic values, the method according to equation (11) will begin to become stepped, until finally we come down to a realistic value for the speed, at which the steps in the energy-results will become too large for a serious data-evaluation according to equation (11). This is the reason according to which I decided to perform the energy-computation according to (12). Equation (12) does not go back to the speed of motion „v" of the magnets, and thus it is not influenced by the question, whether this speed is fast or slow. The data-protocol in the Excel-columns is made for both types of computation, namely for the result of equation (11) in column "K" (see line 337) and for the result of equation (12) in column "L" (see line 338).

And it is clear in any case, that the data being used for the design-development of the MMDR-motor, are taken according to column "L" and equation (12). In line number 341 of the source-code these data are printed directly to the screen, when the program is running. The lines number 344-346 have the task to calculate the mechanical power of one magnet-rotor of the MMDR-converter, as it was explained in the equations (1), (2) and (3) of section 3. The power is calculated as energy being converted per time (from ZPE-energy into kinetic energy), where the energy is the energy per one complete magnet-passage, and time-interval is the durance of just this passage (referring to Fig.2, because of the rotational-speed of the disk containing the magnets).

The remainder of the source-code (from line 349 to the very end) only has the purpose, to supervise the data-recording into the Excel-file, including the management of the counter-numbers of the Excel-recording-files, if the user wants to have this option. Thereby the program is ready for use, namely for the practical design-development of a prototype of a MMDR-converter according to the FPSIF-theory, this means with regard to the finite propagation speed of the magnetic fields. Thus, the next section of the present paper focuses our attention to the practical design of a "MMDR" magnetic motor, discussing about the aspects of Physics of the development of such an engine-design.

4. Practical design of a powerful MMDR-ZPE-Motor

The purpose of the algorithm, as being explained up to now, is of course its application; this is the practical design and development of a MMDR-motor, which can actually work to convert ZPE-energy into classical mechanical and electrical energy. This is the contents of section 4 of the paper presented here.

Already after very few test-runs of the algorithm, it was immediately clear, that the computer-simulation of a ZPE-magnetic-motor absolutely needs that the explicit consideration of the FPSIF-principle. There is no other way to tap ZPE-energy with a magnetic engine, so that any former assumption, the implicit consideration of the finite propagation speed of the interacting fields might perhaps be included into the basic laws of physics (Biot-Savart, Lorentz-force, Induction-law), is for sure disproven. (This restriction is not valid for the electrostatic-rotor, which I verified at the Otto-von-Guericke University in Magdeburg, because this engine does not require alterations of the field.) This has the consequence, that the necessary velocity of the magnets, is much much higher, than assumed in all of my former EMDR-publications, where the FPSIF-principle was not taken explicitly into account. In these former publications (and their algorithms), some numerical artifacts had been observed later, which are corrected and excluded now, due to the explicit application of the "finite propagation-speed of the field".

Fortunately, the new calculations (being published here) teach us, that a ZPE-magnetic-motor can be realistically constructed and built up, with realistic dimensions, and with realistic speed an angular velocity of the magnets (without the former artifacts of numerical computation). The readers will see this, when they follow the design-development, as printed on the following pages. However, from the new computations (including the FPSIF-principle ***explicitly***), we come to the conclusion, that the speed of the interacting magnets must be much faster, than it was ever considered before (without including the FPSIF-principle ***explicitly***). The result of the correct computations is as following:

If we decide to use a rotating disk (containing the magnets), which has a diameter of about 1 to 2 meters, our algorithm will display the results as printed in table 2. It is based on the following geometrical parameters:

Length of each single magnet: L = 0.04 Meter (4 Centimeters)
Inertial Masse per each magnet (if necessary, including the mass of the rotating disk): m = 0.2 kg
Holding force of each magnet: Fmax = 80 Newtons

The discussion of the results is following after table 2.

Line-no.	Diameter of the rotor-disk	Number of magnets being mounted on the circumference of the rotating disk	Vanf [m/s] Initial speed of the magnets at the beginning of each magnet-passage	Angular velocity [U/min] of the rotor disks (relatively to each other) carrying the magnets	Power [Watts] For the total rotor	Excel-File: Results of the simulation, as can be obtained with the source-code in the appendix.
1	2.00 Meters	58	$2 \cdot 10^8$ m/s	$1.910 \cdot 10^9$ U/min	237.3 GigaWatts	Publi_Zeile_01
2	2.00 Meters	58	$2 \cdot 10^7$ m/s	$1.910 \cdot 10^8$ U/min	2.04 GigaWatts	Publi_Zeile_02
3	2.00 Meters	58	$1 \cdot 10^6$ m/s	$9.55 \cdot 10^6$ U/min	7.022 MegaWatts	Publi_Zeile_03
4	2.00 Meters	58	$2 \cdot 10^5$ m/s	$1.910 \cdot 10^6$ U/min	284.6 KiloWatts	Publi_Zeile_04
5	2.00 Meters	58	$2 \cdot 10^4$ m/s	191 000 U/min	3.76 KiloWatts	Publi_Zeile_05
6	1.00 Meters	28	$2 \cdot 10^4$ m/s	382 000 U/min	1.82 KiloWatts	Publi_Zeile_06
7	1.00 Meters	28	$1 \cdot 10^4$ m/s	191 000 U/min	454 Watts	Publi_Zeile_07

Table 2: Overview over several examples of the computer-simulation of MMDR-magnetic-motors

The Pascal-algorithm (source-code, see appendix), calculates the solution of the differential-equations of the motion of the magnets, relatively to each other (as being explained in the sections 1-3), taking the finite propagation speed of the interacting magnetic field into account, based on a trace-back procedure (as explained in the sections 1-3) of the trajectories of the interacting partners. But the algorithm was not developed “foolproof” (because of a maximization of the work-efficiently during the development of the program), so that every user has to check her or his input-parameters for plausibility, as well as the obtained results. An example for the importance, to check the input-parameters, is also the use of a sensible number of discrete steps for the resolution of the trajectory (parameter „SZ“, see line 184, extremely important in order to avoid numerical artifacts !), as well as the duration of each time-interval from step to step (parameter „delT“, see line 185). The allocation of these parameters is to be explained as following – and only with such allocation, the algorithm makes sense:

The motion of the magnets along their trajectories begins for the magnet no.1 at the position $X=+X_{anf}$ (with negative value of X_{anf}), because magnet no.1 starts its path on the left side, and for the magnet no.2 at the position $X=-X_{anf}$. In order to be sure, that we do not have a computation-artifact, based on the conversion of classical potential energy of the magnets in the field of each other (as it would be also possible in a static consideration without taking the finite propagation speed of the fields into account), the motion of the magnets along the trajectories has to end exactly at the mirror-image of the starting positions, namely when magnet no.1 arrives at the position $X=-X_{anf}$ and magnet no.2 arrives at the position $X=+X_{anf}$. To assure this, we must be certain, that the starting-velocity V_{anf} and the total duration of the observation „SZ·delT" exactly come to the distance $2 \cdot X_{anf}$ according to equation (13). (Meaning of the parameters: "SZ" = number of time-steps, and "delT" = duration of each time-step.)

$$\left.\begin{array}{c} s = 2 \cdot X_{anf} \\ t = SZ \cdot delT \\ s = v \cdot t \end{array}\right\} \Rightarrow 2 \cdot X_{anf} = SZ \cdot delT \qquad (13)$$

In order to achieve a sensible presentation of the results, respectively of all output-data, which will be forwarded to Excel, "SZ" should be in the range of 1000…20000 (or larger); X_{anf} is predetermined and delT must match to the value of X_{anf} . To assure, that both of the trajectories, span the complete motion including deceleration and acceleration for a complete magnet-passage, it is necessary to plot always for every data-evaluation, the Excel-columns „D" and „L" against each other (this is the alteration of the kinetic energy as a function of the magnet's positions, as we see from the contents of the columns, being explained in table 1). The results of such control can be recognized quite well in the Figures 11, 12 and 13, where the actual alteration of the kinetic energy of the (left) magnet, relatively to the kinetic energy in the initial state of the magnet-passage, is being plotted as a function of the magnet position. When the magnet is located at the very beginning of the magnet passage (here X_{anf} = –20cm), it has of course exactly its initial kinetic energy, and thus the alteration of the actual kinetic energy compared to the initial kinetic energy is (as a matter of fact) ZERO. (This is of course a tautology.) When the magnet-passage begins to run, the both magnets approach to each other, due to their predetermined initial velocities, and because the magnetic forces are repulsive during this phase of the motion, the magnets decelerate each other (decreasing their kinetic energy). The deceleration is active, until the both magnets reach the origin of coordinates at X=0 (as long as according to Fig.6 the magnet-force is negative), where they come most close to each other, laying parallel to each other. At this position we have the minimum of the kinetic energy. From the initial moment of the passage, up to the moment at X=0, the magnetic force is repulsive and thus it leads to a deceleration. From the moment on, when the magnets have passed the position X=0, the repulsive magnetic force turns to be an accelerating force (the force is positive during this phase of the motion, see Fig.6), so that behind X=0, the kinetic energy is increasing.

The main central consequence of the FPSIF-theory is, that during the phase of the motion, when the magnets approach towards each other, the (repulsive, decelerating) magnetic force is reduced, whereas in the opposite way around, during the phase of the motion, when the magnets run away from each other, the (repulsive, accelerating) magnetic force is now enhanced. This has the consequence, that the deceleration is less strong than the acceleration along one magnet-passage, so that during the first half of the passage (the phase with X<0), less kinetic energy is lost, than in the second half of the passage (the phase with X>0) is gained, so that at the end of the complete passage, the kinetic energy is larger than it had been at the very beginning of the passage. We can see this very clearly in Fig.11.

However, it must be emphasized, that Fig. 11 corresponds to the computations in line 2 of table 2, this is an extremely fast velocity of the magnets of $2 \cdot 10^7$ m/s, nearly 6.7 % of the propagation speed of the magnetic field, which is assumed (here in present paper) to be the vacuum speed of light. Of course it is no wonder, to see such a strong enhancement of the kinetic energy (being gained from the ZPE-energy) at such (unrealistic) a high speed of the interacting partners. The plot of Fig.11 is made to illustrate and demonstrate the functionability of the FPSIF-principle, but the speed is too large for a practical engine.

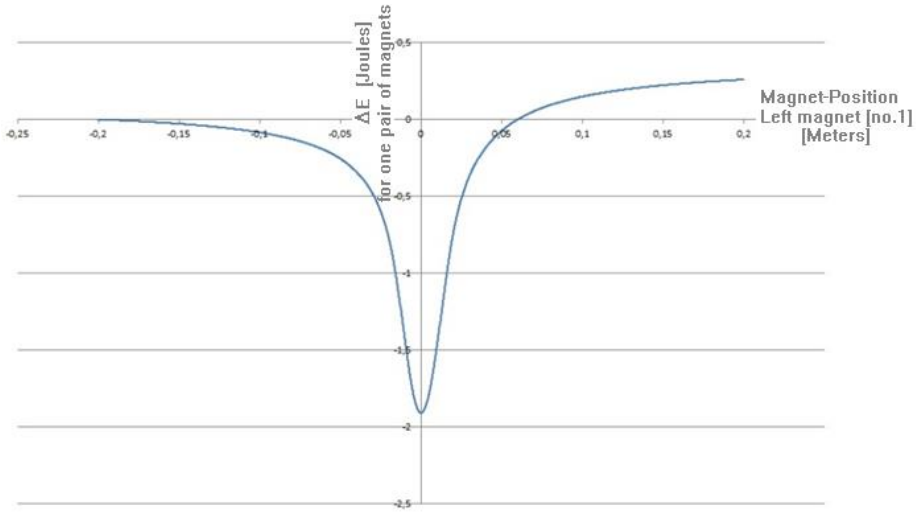


Fig.11:

Alteration of the kinetic energy of each of the magnets during one magnet-passage.

The graphic represents line 2 in table 2, at which the speed of the magnet's motion reaches several percent of the speed of light.

The conversion of ZPE-energy is very clear.

The closer the speed of the magnets comes to the speed of light (actually to the propagation speed of the interacting fields), the larger we find the enhancement of the classical energy (being supported from ZPE-energy). We see this most drastically in Fig. 12, which is based on the computation of line 1 table 2, where the magnets move with the speed of $2 \cdot 10^8$ m/s, this is nearly 67 % of the propagation speed of the magnetic field. In this case, the delay between „actio" and „reactio" in Newton's axiom is so strong, that the energy gain from ZPE-energy is much larger, than the energy-difference being consumed for the deceleration of the magnets, during the phase when they approach to each other (which is the first half of the magnet-passage). We shall not forget, that the energy-difference in the plot, is the energy-gain of each single passage of each single pair of magnets – and we have many such during the rotation.

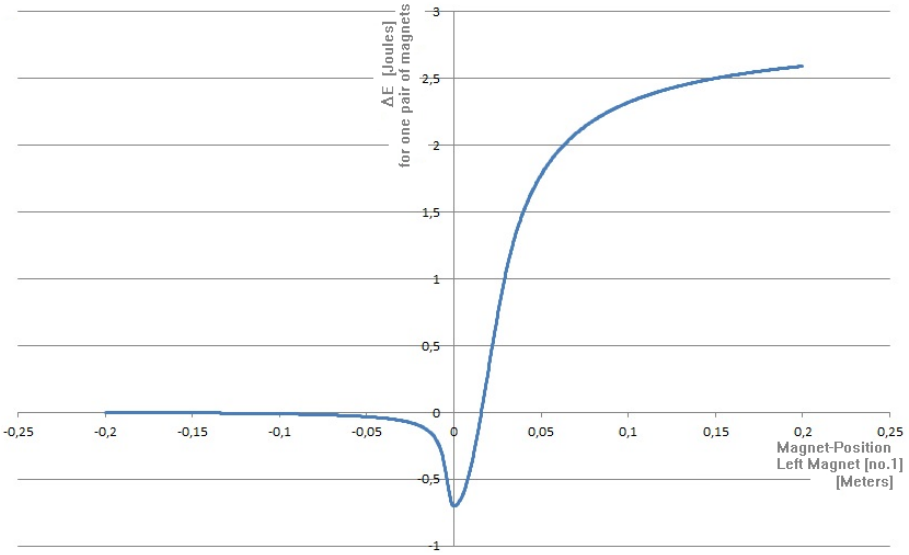


Fig.12:

Alteration of the kinetic energy of each of the magnets during one magnet passage.

The graphic represents line 1 in table 2, at which the speed of motion of the magnets reaches almost two thirds of the speed of light.

The conversion of ZPE-energy is extremely massive.

It is clear, that such an operation of the ZPE-energy converter (as shown in Fig. 12) is of course absolutely unrealistic, because the rotating disk carrying the magnets, has to carry real existing magnets, made from material with real existing inertial mass, and it is of course not possible, to bring such material to such high speed with our technology available for mankind nowadays. Not only the relativistic increase of the moving masses would be a (minor) problem, but also the bearings and the centrifugal force, which is for sure too strong for any real existing material. A disk, rotating so extremely fast, would excess the stress limit of every available material, by several orders of magnitude.

Indeed it is clear, that a real existing design of the very first prototypes of an MMDR-magnetic-motor, has to respect the limits of technical mechanics, as there are for instance among others, the necessity of a really existing bearing for the rotating disks, and the material's strength of the rotating disks, carrying the magnets. In order to prepare the communication with mechanical engineers (and to make the considerations most easy), the computations within the lines 3 … 7 in table 2 have been performed.

Before we tend our attention to these lines, we want to regard a short formal remark for the illustration of the FPSIF-theory:
Of course, we know Newton's axiom „actio=reactio“, according to which every force is opposed by an anti-force of the same absolute value, but with the opposite direction, so that both forces (force and anti-force) always compensate each other exactly by principle. This is said by Isaac Newton, as long as the finite propagation speed of the force-transmission is not included into the consideration. But as soon as we take this finite propagation speed of the force-transmission into account, in extension to Newton's considerations (and this is exactly the feature of the FPSIF-theory), the „reactio“ is acting with delay compared to the „actio“. This means, we borrow some force from the quantum-vacuum (and together with the force also on some energy), and we give it back later to the quantum-vacuum, making it work for us in the meantime, as long as we can loan it from the quantum-vacuum (for free). Of course this perception is shirt-sleeved (very relaxed), as we say it in German proverb, and it sounds more popular than scientific, but nevertheless it also helps specialists, to make themselves clear with a light smile on the face, to understand how the FPSIF-theory is working: We borrow some energy from the quantum-vacuum, we use it, and we give it back to the quantum-vacuum later (following „actio=reactio“ with a certain delay), without paying "interest" for it, so that we can keep the interest as our benefit.

We now want to end our humoristic insertion and tend our attention concretely to the design-development of the lines 3…7 in table 2:

The graphical display of the functions of the alteration of the kinetic energy of the magnet, during one complete magnet-passage is rather similar for different situations with different values of the speed of the magnet; thus it is sufficient now to show only one more plot of this type (and not many of them), which is representative for all those, occurring under several different values for the speed of motion, of the interacting partners (magnets). This graphical display is to be seen in Fig.13. Because of the practically achievable speed of the magnets, due to practical technical limitations, the speed of the magnets is rather moderate in comparison to the vacuum speed of light. This has the consequence, that the increase of the kinetic energy (following the FPSIF-theory) can be seen only very slightly in the graphical plot. Nevertheless, this energy-increase can be seen, is existing, and it is large enough to constitute a technical sensible utilizability of the MMDR-magnetic-motor. In comparison to the amount of energy being available in the quantum vacuum, the convertible percentage of this energy is rather small, but this is not a problem, because the energy density of the quantum vacuum is so tremendously large, that a ZPE-motor under realistic circumstances, will give a useful amount of energy and power – please compare lines 1 and 2 in table 2, which only have purpose to illustrate, how enormously large the energy density and the power density of the quantum vacuum really is. This makes clear, that a very very small percentage of this energy and power, is already absolutely sufficient for technical applications. Obviously also in Fig.13, the energy at the end of the motion is a little bit different from the energy at the beginning of the motion – and this is already enough for a useful engine.

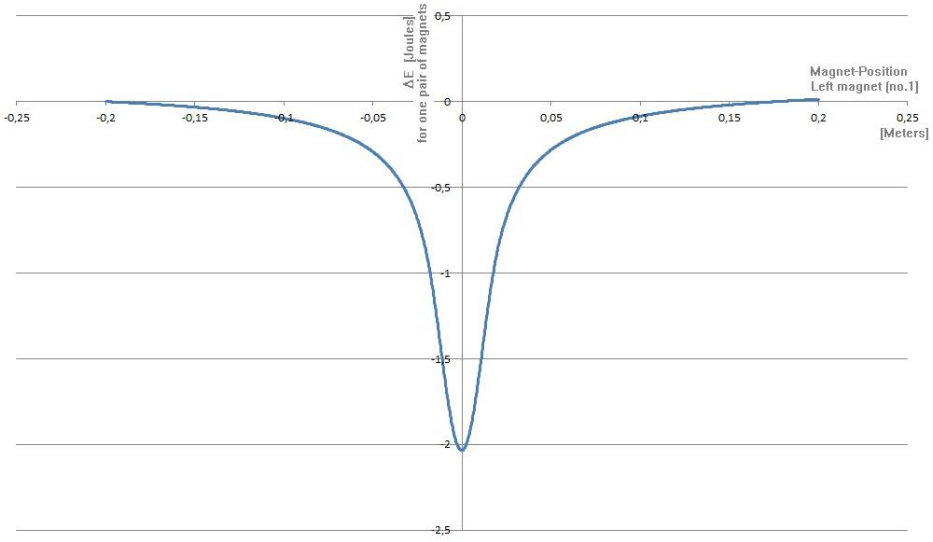


Fig.13:
Alteration of the kinetic energy of each of the both magnets during one magnet-passage.
The graphic represents line 3 in table 3, at which the speed of motion of the magnet is moderate enough to be practically realizable. The ZPE-energy conversion can be recognized only, when we look to the graphic very exactly, but its numerical evaluation is no problem.

We understand this as following:

Lines number 1 and 2 in table 2 have the purpose, to illustrate how tremendously large the available energy-density of the quantum vacuum really is. If it would be possible to move the magnets in two disks containing magnets with two thirds of the vacuum speed of light (relatively to each other), a setup with a diameter of 2 meters and a thickness of few centimetres, could produce an output-power of more than 230 GigaWatts. This is absolutely inconceivable with our human imagination, and the example only shall illustrate to the readers, that the energy density of the quantum-vacuum is really very very large.

The MMDR-magnet-motor as presented here (different from former conceptions of the EMDR-magnet-motor), does not have any principle systematic limitation of the angular velocity (of the magnets), and this makes it necessary, to assemble a measuring device for the angular velocity (reacting extremely quick !!), which automatically (under electronic control) activates a break-/retarder system, which has the purpose to slow down the angular velocity of the rotation immediately, as soon as its value exceeds a predefined limit. The predefinition of this limit must be adjusted to the stability of the mechanical components of the MMDR. This is absolutely indispensable, because the amount of power being extracted from the ZPE-energy increases (as a function of operation-time of the MMDR), as long as we do not extract power by a consumer of by a break-system. The conversion of energy from the quantum-vacuum enhances the kinetic energy of the magnet-rotor, which in turn has the consequence to enhance the amount of power being converted from the ZPE-energy, which in turn has the consequence to enhance the kinetic energy of the magnet-rotor, which in turn has the consequence to enhance the amount of power being converted from the ZPE-energy, and so on . . . .

If the control mechanism and the break system shall not be strained too much, the magnet-rotors in standby-mode (if only a small amount of power shall be extracted for the benefit of the user), the rotors have to be kept under “moderate” angular velocity, which is just even enough to compensate the power, which is delivered to the user and additionally the power necessary to overcome the friction in the system. Thus, the angular velocity (and with it, the amount of power being converted from the quantum-vacuum), has to be adjusted all time to the requirements of the user and of the friction (inside the MMDR-engine). By regulation of the angular velocity (of the speed of motion of the magnets), extracted power from the quantum-vacuum can be and must be adjusted permanently to the requirements of the engine. For the sake of the efficiency, the power being extracted from the quantum-vacuum, shall be taken by a regulated consumer (as for instance by an electrical generator). Nevertheless, for security reasons, a very powerful break must be present, which can react to a reduction of the power-consumption (for instance by an electrical generator as a consumer), but which also must have the ability, to bring the rotor completely to standstill immediately, if required. This is absolutely indispensable, because the MMDR-magnetic-motor will enhance its angular velocity by alone, if it is not under strict control. And without control, this enhancement of the velocity, will only end, when the velocity is so large, that the components of the machine are broken, so that they fly away centrifugally. For the sake of safety-reasons, this break-system has to be operated automatically.

Let us now tend our attention the numerical results, presented in the lines 3-7 in table 2:

Line 3, with its angular velocity of nearly 10 millions of rounds per minute, is of course still completely unrealistic, and only has the purpose, to make the transition understandable from unrealistic fast motion to realizable speed of motion. In principle, the same argument is applicable for line 4, but we can seriously pose the question, whether an angular velocity of 1.9 million of rounds per minute will be realizable in conceivable time of development ? This idea is not really ridiculous, because the value of 1.9 million of rounds per minute, describes the angular velocity of both magnetic disks relatively to each other, so that each of both disks only to rotate with half of this angular velocity, when we build the engine with two disks, spinning into directions opposite to each other. This means, that each of the disks can have 950.000 rounds per minute – and it is now possible to find little electromotors with 1 million of rounds per minute from series production [Cel 13]. Even standard turbo-charger rotors in automotive industry, are working nowadays in in the range of 250.000 und 300.000 rounds per minute in low-priced fabrication of line production. If we look to the power-output of 284 kW in line 4 of table 2, the production of a MMDR-magnetic-motor will even make the power density imaginable for automotive technology.

From line 5 on, we regard MMDR design-suggestions which can be realized with normal today's technology. These can be suggestions for the very first prototypes, that will have to prove the functionability of the concept and the system. A rotor with a diameter of 2 meters and an angular velocity of a bit less than 191.000 rounds per minute, as shown in line 5, will bring a power-output of more than three Kilowatts. If one of the disks is kept in rest, and the other one is rotating, we have a value of the angular velocity, which is still below today's series line production. If we make both disks rotating with directions against each other, each of the disks will have to rotate with an angular velocity of a bit less than 96.000 rounds per minute, which should be absolutely no problem. Only the diameter of the disks of 2 meters puts serious demands to the technology of dynamical real balancing, so that not any transverse-forces will destroy the bearings, due to an imbalance of the rotating masses.

Because the power being converted from ZPE-energy (according to FPSIF-theory) increases with the square of the angular velocity (even a bit stronger than with the square), the power-output of the MMDR-magnetic-motor can be enhanced without any problems (as indicated in line 5) into a range, which begins to be interesting for the technical power-supply of private houses: If we enhance the angular velocity from 96.000 to 150.000 rounds per minute (in each of the both magnetic rotating disks), the power will be enhanced by a factor of $(150.000/96.000)^2$=2.44 (or even a bit more). When we multiply this with the power of 3.76 kW (at 2·96.000 rpm), we receive a power-output of 9.18 kiloWatts (at 2·150.000 rpm). An engine of this dimension should be sufficient to supply a private house, and this engine might have a size of about 2.5x2.5x2.0 m^3 (due to the housing, the engine will of course be little bit larger, than the mere rotating magnetic disks), so that it can be mounted in a small cabin in the cellar very easy.

Lines number 6 and 7 in table 2, have the purpose to present possible dimensions for a very first prototype, for scientific investigations and for the development of a very first construction. For this purpose (as it should be tested), probably a diameter of 1 meter (of the magnetic disks) should be enough, so that one disk in rest, and one rotating partner-disk with a bit less than 200.000 rounds per minute, will convert a power of about 450 Watts from the quantum-vacuum. When we enhance the angular velocity to about 390.000 rounds per minute, the setup should be expected to deliver a power-output of about 1.8 kW. For a fundamental scientific proof, and for the compensation of friction-losses, as well as for the purpose of demonstration, that the engine can deliver useful (mechanical/electrical) power (a generator can be attached), this should be fairly sufficient, so that there is also some buffer, that we can expect to surmount also unexpected power losses.

When we remember, how strong the output-power is being enhanced with the diameter, a larger rotating magnetic disk, arises the expectation of a remarkably enhanced output-power:

Line 7 → diameter 1 Meter → output-power of 450 Watts (at 2·100.000 rpm)
Line 5 → diameter 2 Meters → output-power of 3700 Watts (at 2·100.000 rpm)

The output-power is increasing with the third potential law of the diameter, which allows us extrapolate:
=> diameter 5 Meters → output-power $(5)^3/(2)^3$·3700 Watt = 25.625·3.7kW=57.8kW (at 2·100.000 rpm)
diameter 10 Meters → output-power $(10/2)^3$ · 3.7kW = 462kW (at 2·100.000 rpm)

We can further enhance the output-power by a further enhancement of the angular velocity (the power increases with the square of the velocity), and thus we can further extrapolate:
By going to the double of the angular velocity:
=> diameter 5 Meters → output-power $(2)^2$ · 57.8kW=231kW (at 2·200.000 rpm)
diameter 10 Meters → output-power $(2)^2$ · 462kW = 1.85 MegaWatts (at 2·200.000 rpm)

And by multiplying the angular velocity with a factor of three:
=> diameter 5 Meters → output-power $(3)^2$ · 57.8kW=520kW (at 2·300.000 rpm)
diameter 10 Meters → output-power $(3)^2$ · 462kW = 4.16 MegaWatts (at 2·300.000 rpm)

This leads us to dimensions, which allow not only the technical power supply for private houses, but also for large industrial companies.

By the means of a remarkable enhancement of the angular velocity, it will be no problem to achieve a power density being interesting for automotive applications. For instance on line 7, we can build up a scenario, by enhancing the angular velocity by a factor of 10 or 20, as following:

diameter 1 Meter → output-power $(10)^2 \cdot$ 450 Watt = 45 kW = 61 PS (at $2 \cdot 1.000.000$ rpm)

diameter 1 Meter → output-power $(20)^2 \cdot$ 450 Watt = 180 kW = 245 PS (at $2 \cdot 2.000.000$ rpm)

The more we can enhance the angular velocity, the smaller the dimensions will be.

And finally we should remember, that modern "Super-magnets" have a holding-force of much more than 80 Newtons (as used in our computation). If we apply such efficient material, the force and the power being extracted from the quantum-vacuum, will increase linearly with the holding-force of the magnets.

The design-suggestions as being presented here up to now (based on an interaction-force between the magnets of 80 Newtons in the minimum of the distance between the magnets), should be available with low-cost classical magnetic material, which does not need any rare-earth Super-magnets. This makes the general disposability of the material for the magnets very easy. This is important, because any ZPE-converter, which only can work with rare-earth materials, would have the consequence of scarcity of rare-earth material soon – and this would definitely not be the solution of the energy-problem of mankind. It shall be emphasized here explicitly, that for the very first prototypes for scientific purpose, rare-earth magnets can be applied without problems, but for the line production with large numbers of MMDR-motors, rare-earth magnets are absolutely not necessary, so that the general energy-supply for everybody is definitely ***not*** restricted by this material.

4.1. Remarks regarding a technical realization

For the very first investigations, namely for the experimental verification of the fundamental functionability of the FPSIF-principle, very special bearings with extremely low friction can (and should) be applied, as for instance air-suspension technology, or contactless magnetic bearings (as instance with Halbach-Arrays [Hal 13]), which additionally allow very high relative speed of motion.

If we build magnet-rotors, for instance as being presumed in table 2, line 7, (inertial mass m = 0.2 kg, holding-force of F_{max}= 80 N per each magnet), the magnets will run along a circular path, leading to radial forces according to equation (14).

$$\left.\begin{array}{ll} \text{Radius of rotation} & r = 0.5m \\ \text{Angular velocity} & \omega = 191000\dfrac{U}{\text{min.}} = 191000\dfrac{2\pi\, rad}{60\,\text{sec.}} \end{array}\right\} \Rightarrow F_R = m\omega^2 r = 40000000\ \text{N} \qquad (14)$$

If the magnets are mounted within fibre-reinforced synthetical plastic (we absolutely need noncomductive and non-ferromagnetic material), we can for instance put the value of σ = 1300 N/mm² for the tensile strength of the material into our exemplary numerical estimation (see for instance page 65 in [Bög 07] with a polymer „EP-CF 70"), which I feel to be an astonishing large value, not to expected in the context of plastic material. This value helps us, to get a stable rotor and allow large angular velocity. By equation (15) we calculate the cross-section area which is necessary to absorb the force of equation (14).

$$\text{With}\quad \sigma = \frac{F}{A}\quad \text{we come to}\quad A = \frac{F_R}{\sigma} = \frac{40000000\ \text{N}}{1300\,N/mm^2} = 30770\,mm^2 \qquad (15)$$

This should be a realizable order of magnitude, but for a real practical prototype of an MMDR-engine, a professional strength- and reliability- analysis of the material should be performed, with a commercial finite element program (FEM).

Should some limitations in the availability of real synthetical plastic material bear the consequence (after performing an appropriate finite element analysis), that the radial force has to be further reduced, this should not be a problem, because the linear translational speed (this is the important one in the FPSIF-

theory) of the circulating magnets, can be kept constant, by enhancing the radius of the rotation and reducing the angular velocity at the same time. Equation (16) is generally known beginners knowledge:

$$\vec{v} = \vec{\omega} \times \vec{r} \tag{16}$$

So, when we double the radius of the rotation, and keep the linear translational speed constant (in order to keep the efficiency of ZPE-conversion constant, i.e. the converted power), we can come to half of the angular velocity, and by this means to half of the radial force, as being seen in equation (17).

$$\left.\begin{array}{l} \text{Radius of rotation} \quad r = 1.0\,m \\ \text{Angular velocity} \quad \omega = 95500\dfrac{U}{\text{min.}} = 95500\dfrac{2\pi\, rad}{60\,\text{sec.}} \end{array}\right\} \Rightarrow F_R = m\omega^2 r = 20000000\ \text{N} \tag{17}$$

Consequently, the minimum size of the MMDR-converter is a mere question of the material stability of the rotating disks, which carry the magnets: The diameter of these disks must be large enough, to make the radial force small enough, that the material can withstand the rotation (with its speed). This means, that the FPSIF-principle allows upscaling the MMDR-magnetic-motor without any restrictions, but downscaling (of the dimensions) is restricted by the stability of the available materials.

Nevertheless, the high angular velocity (and the high speed) of the magnets should not be a fundamental problem, because we know that in automotive industry, turbo-charger rotors with an angular velocity of about 200.000-300.000 are fabricated in low-cost standard production. By the way, motors with a full million of rounds per minute are already available in series production (see for instance [Cel 13]).

For a later optimization of the setup, it would be recommendable to investigate, whether ceramics or even ceramics-composite is a better material, with higher values of tensile strength and rupture strength than plastic materials. This might lead to an even further reduction of the installation space, of the rotating magnetic disks.

Independent from these optimizations, the wheel-balancing procedure of the rotating disks, will have to be solved from the very first experiments and the very first prototype on, in order to make the high-speed run of the magnetic disks possible at all. The wheel-balancing procedure is essential for the bearings.

Because of the fact, that geometrically not too small (i.e. large) units allow a high translational linear velocity of the magnets (and furthermore, due to the available space, large rotors allow a large number of magnets), leading to a massive enhancement of the power being converted from ZPE-energy, and furthermore the material stress is reduced with increasing diameter of the rotating disks, probably the very first MMDR-units going to market, will be in the range of large power output (not small power), so they would probably be interesting for large consumers (as for instance for industrial companies). With the experience being collected on these units, it should be a question of several months, to advance the development in order to get small units of several kilowatts, for the application in private houses.

Rotation speed control, Limitation of the Rotation speed, Break-system:

ZPE-converters, which work according to the FPSIF-theory, always require by principle, a speed of motion of the interacting components, which arrives at a serious percentage (see table 2) of the speed of light. This is the case at the EMDR-converter, an in the same manner, at the MMDR-converter, same as with those other ZPE-converters (see section 5 of the preceding publication), which are developed on the fundament of the same theoretical basics.

And it is absolutely clear (from the preceding example-computations), that an increase of the velocity of the motion, leads to a tremendously (stronger than proportional) increase of the amount of power being converted from the quantum-vacuum. This leads to several consequences, among them also the fact, that there is a “significant velocity v_S”, which defines a clear threshold between the starting mode of the engine and the self-running operation mode of the same engine. This can be explained as following:

The power being converted as a function of the velocity $P(v)$ is a (higher than proportional) strictly monotonous growing function of v. As soon as v is fast enough, that $P(v)$ surmounts the amount of power being necessary to surmount friction P_{friction}, this is $P(v) > P_{\text{friction}}$, the ZPE-machine begins to come into the self-running operation mode. The threshold therefore is $P(v_S) = P_{\text{friction}}$. From this equity, we will find the significant velocity v_S, as following:

- For $v < v_S$ the ZPE-engine is in the starting-mode.
- At $v = v_S$ we have the threshold between the both modes of operation.
- For $v > v_S$ the ZPE-engine gains useable power from the quantum vacuum.

During the starting-mode, classical kinetic energy has to be inserted into the rotating magnetic disks, in order to enhance their angular velocity. As soon as $v \geq v_S$ is achieved, it is not necessary to insert any further classical energy.

If we want to extract useful power from the ZPE motor, we have two consider a second significant speed, which we can call the "significant speed for power conversion v_L", at which we have the power-relation $P(v_L) = P_{\text{friction}} + P_{\text{util}}$ (with $P_{\text{friction}} =$ power due to friction and $P_{\text{util}} =$ power being extracted for utilization). Therefore, we derive the following necessities for the application of the engine:

During the starting-mode, the rotation has to be initiated (similar as it must be done with a gasoline-motor, when the user actuates the starter). In the case of magnetic ZPE-motors, the velocity of the magnets has to be enhanced from $v = 0$ up to $v = v_S$ by inserting energy from the starter. From the moment on, when the velocity of the magnets exceeds the threshold of $v = v_S$, the starter can be de-clutched and the external insertion of energy can be stopped. From this moment on, the velocity of the magnets, respectively the angular velocity of the magnetic disks, is being enhanced by alone, being supported from the energy of the quantum vacuum.

As soon as $v > v_S$ is reached, the acceleration of the MMDR-engine has of course no limit by nature, and the angular velocity would increase, until finally the material would be broken – if there would not be a system consuming power (transferring the power to the user, or into a break system). At the EMDR-concept, the limitation of the angular velocity had been realized, by the means of an electrical LC-resonance-circuit, which ensures a very high (perfect) operation safety, because the magnetic signals (i.e. the electrical currents in the coils producing the magnetic field), and with them the angular velocity, can by principle never exceed the resonance frequency of the electrical LC-resonance-circuit. On the other hand, the LC-limitation-concept has the (remarkable) disadvantage, that electrical losses in the coils, in the capacitors and in the electrical wires, create additional losses, which have to be compensated in addition to the mechanical friction-losses. Thus, for the EMDR, an additional term has to be included into the power equation, namely an electrical loss-equivalent, leading to a threshold power of $P(v_S) = P_{\text{friction}} + P_{\text{electr.losses}}$, which makes as a matter of fact, the significant velocity v_S remarkably faster, than it had been necessary at the MMDR. This has the consequence that the bearing-problem and the wheel balancing procedure of the EMDR, are much more complicated, than the bearing problem and the wheel balancing procedure of the MMDR.

The MMDR-concept was developed, in order to avoid such problems in connection with the necessary compensation of electrical losses, but it has the disadvantage, that of the velocity limit by principle, has to be replaced by some other (electronically controlled) limitation of the angular velocity, using an additional break-system. The break system could be for instance a classical mechanical brake, as being used in the automotive industry, but it could also be a wearless eddy-current retarder, or some other system. Whatever retarder-system we use, first of all it is mainly important, that the break/retarder-system ***must*** be operated automatically, under electrical control, because a system under hand-control will never be secure and (first of all) not fast enough, even not for the very first prototype in the research-lab.

The electronic control of the retarder-system must have a sensor, which permanently monitors the angular velocity, so that it can immediately actuate the retarder-system, to be sure forever, that the angular velocity will never exceed the limit, which is to be respected, that the material will not be

broken. For series production, the retarder-system has to be designed in a way, that it can withstand decades of years of operation, but it will not be a problem to make annual maintenance for renewing brake shoes. (Perhaps, a good alternative might be an eddy-current brake.)

Of course it is sensible to restrict the angular-velocity of the rotation (and the speed of the magnets) in such way, that the power being converted from ZPE-energy is just exactly enough to supply the power-condition of $P(v) = P_{\text{friction}} + P_{\text{util}}$ without taking more than necessary power for security-retardation of the rotating magnet-disk. This means, that the angular-velocity of the rotation shall be adjusted and controlled permanently in such way, that the converted power $P(v)$ supplies all necessary power-losses and also the power-consumptions $P_{\text{friction}} + P_{\text{util}} + P_{\text{retarder}}$ exactly in such way, that P_{retarder} is minimized. With other words: $P(v) \geq P_{\text{friction}} + P_{\text{util}} + P_{\text{retarder}}$ must be respected during all time, in order to keep the engine in self-running mode, while P_{retarder} shall be as small as possible at the same moment, in order to minimize the wear of the break/retarding-system. Nevertheless, thereby must be kept in mind, that one single moment with $P_{\text{retarder}} < 0$ would lead to the consequence, that the MMDR-engine would stop to stay in the self-running mode of operation, because in this case we would have the consequence of $P(v) = P_{\text{friction}} + P_{\text{util}} + P_{\text{retarder}} < P_{\text{friction}} + P_{\text{util}}$, and this is of course not enough, that $P(v)$ could supply the condition $P(v) \geq P_{\text{friction}} + P_{\text{util}}$ for the self-running mode. This means that the minimization of P_{retarder} has to respect a security-distance from zero, being $P_{\text{retarder}} > 0$, so that we are sure not to lose the self-running mode of operation, because as soon as we lose this mode, the engine would come to standstill and would have to be restarted from the very beginning. (As an alternative, it might be a possible idea, to store some energy (being extracted from the quantum-vacuum) in some intermediate energy-reservoir, so that it can be re-supplied as soon as the angular velocity of the rotation will be only by a small amount too slow to keep the self-running mode of operation.)

5. Other ZPE-Converters following the FPSIF-Theory

Of course, the manufacturing and distribution of many MMDR-converters, can convince everybody, that the utilization of ZPE-energy is possible even with engines from series line-production. The situation of ZPE-research reminds somehow to the situation of automotive-industry in the end of the 19th century: People did not believe that a horse-coach might be driven without horses, so that the inventor of the automobile, Carl Friedrich Benz, had been made ridiculous with his work, which was called the “Benz-Patent Motorwagen Nr.3” in 1985. The situation could be changed only, when his wife Cäcilie Bertha Benz did the first tour, a car-ride from Mannheim to Pforzheim (in 1985) with a distance of 106 km and three days later back home from Pforzheim to Mannheim [Ben 85/88]. Family Benz decided to take Mrs. Benz as driver, in order to demonstrate that the car was not driven by the force of the driver’s muscles. In the same way as the Benz-family helped the car to become accepted, the MMDR-converter can help the ZPE-utilization to become accepted.

It will also be possible to provide the very first units with many Kilowatts, or several Megawatts (because large units are most easy to manufacture), cancelling the necessity of energy-payments. Immediately after such an introduction into market, the MMDR-converters can be scaled down, for the supply of all private houses. Only the very last step will be the scaling-down procedure for the supply of cars, because the energy-density in car-motors is the highest of all mentioned applications. In automotive applications, a rather small engine has to bring more then hundred Kilowatts, and this makes the requirements to the angular velocity of the magnets most challenging.

But: A further diversification will not be interesting with the MMDR-principle, as for instance the idea, to drive each single electric device with its own MMDR-converter, such as single drilling-machines, mixers in the kitchen or even electrical tooth-brushes. This is, because the fatigue-life of the bearings will become a difficult problem, as soon as we begin to minimize the MMDR-engine too much. Of course, optimal bearings and optimal balancing-systems will have to be developed (even for large engines), but it will be

sufficient to make houses self-supporting; it is not recommendable to make each single electrical engine self-supporting. Socket wall plugs will not be removed from houses.

The fatigue-life aspect of the bearings is most difficult with small entities of the MMDR-converter, and most easy with large entities, and this has the consequence, that the MMDR can be built in units of several kilowatts (see above) or larger, but it cannot be scaled down to a dimension as it is necessary for the supply of a single laptop or a mobile phone – and this is not mainly a problem of vibration, which is additionally not acceptable for the supply of laptos and mobile phones.

After these considerations, it turns out obvious, that also different types of ZPE-energy converters (as alternatives to the MMDR-system) will be necessary (according to the FPSIF-theory, or according to other theories), in order to get the possibility to offer small units to the users of many many small applications. From the moment on, when normal MMDR-magnet-motors will be working in many many houses, the ban of the zero point energy utilization will be overcome, and the research, investigation and development of further even more efficient systems, also with other principles of realization, will not face any further the same non-technical problems, as it is the problem now for the development of the very first MMDR-magnet-motors. In order to illustrate other variations of possible ZPE-engines, the author of the present paper wrote section 5, as beginning now.

5.1. The EEDR-Converter, a nearly „motionless“-system

The name of “motionless-systems” is used in the English language for such ZPE-engines of which the (material) components do not have to be in motion, in order to convert energy from the quantum vacuum. Several systems of this type are being reported in literature. Also the author of the present paper developed one such motionless-system in theory, which has not only than the purpose to demonstrate, how effective and how universal his FPSIF-principle can be applied. The main advantages of such systems are the following both:

- They operate without vibration, thus they are absolutely silent. It is not necessary to encapsulate their noise, as it would be necessary for an MMDR-converter.
- They operate without ware, because there are no mechanical motions and no bearings.

If we regard electrons as elementary particles and not as (material) components of engines, which is a quite usual point of few, when we regard an electrical current in the copper wire (as it is also done in normal standard electrical engines nowadays), the EEDR-converter is such a “motionless-system” (even if the electrons are not within a copper wire). This will be the topic of section 5.1 of the preceding paper. The conception, that electrons running in wires are not components of engines in motion, is always applied for all classical electrical engines and even for electric light bulbs. Nobody would come to the idea, that electric light bulbs contain components in motion. Thus this conception should not disturb anybody.

According to the FPSIF-theory, always the interacting partners have to be in motion, as well as the field transmitting the interaction. Thus, a “motionless converter” according to the FPSIF-theory can be built by bringing some electrons (as elementary particles) into motion, as well as the electrostatic field (the Coulomb-field) which transports the Coulomb-force between the electrons. This led me to the idea of the EEDR-converter, which is an abbreviation for “Electron-electrostatic double resonance” converter. Thereby, the reference to the name of “double resonance” has only historical reasons, because there are no resonances in the functioning principles of the MMDR- and the EEDR- converters.

In the electron-electrostatic system, we have electrons interacting with each other via electrostatic fields (as an approximation, we do not want to consider magnetic fields under these circumstances). Instead of the magnets (at in the MMDR), we now move only electrons (at the EEDR). Because electrons always act with repulsive (Coulomb-)force onto each other (independent from the fact whether they approach to each other, or whether they fly away from each other), we can by principle transform our complete considerations of section 2 and of Fig.1 in total analogy to our EEDR-concept now: So, if we replace our analysis of the magnet-magnet-passage from section 2 by an electron-electron-passage now, we see two

electrons decelerating each other, as long as they fly towards each other (decreasing their distance), and accelerating each other, during the phase, when they fly away from each other.

During the first phase of the passage, when the electrons approach towards each other, classical kinetic energy from the motion of the electrons, is converted into classical potential energy within the Coulomb-potential between the electrons. Due to the finite speed of propagation of the Coulomb-field, the loss of classical kinetic energy during this phase (of the motion) is smaller than the gain of classical potential energy in the second phase of the passage, during which the electrons fly away from each other. The difference of the kinetic energy before and after the passage is being supported from the energy of the quantum vacuum. From the moment on, when both electrons have passed each other, potential energy from the classical Coulomb-potential (of the interaction between the electrons) has been converted into kinetic energy of the (electrons') motion, and according to the FPSIF-theory, the increase of classical kinetic energy is larger than the decrease of the potential energy (being again supported from the energy of the quantum vacuum). The fundamental basic principle of the ZPE-energy conversion, is thus understandable in analogous manner, as it was at the MMDR-converter.

The most important difference between MMDR and the EEDR is, that the electrons can reach extremely high velocity and acceleration extremely easy, because their rest-mass is extremely small. Also the installation of a circular trajectory is very easy with electrons, without any material stress, due to the very small rest-mass of these elementary particles (which are leptons). A circular trajectory can be made with a constant magnetic-field, delivering the necessary centripetal force.

How easy it is, to accelerate electrons to very high speed, can be seen by a simple classical formula of the special theory of relativity, namely when we calculate the speed of the electrons from the voltage, with which we accelerate them, according to equation (18) [Wik 13]:

$$v = c \cdot \sqrt{1 - \frac{1}{\left(1 + \frac{q \cdot U}{m_0 \cdot c^2}\right)^2}} \qquad (18)$$

If we for instance use a voltage of only $U = 12kV$ to accelerate the electrons, we come to a velocity of $v = 63842763\frac{m}{s} \approx 21.28\%\,\mathrm{c}$.

Obviously it is not very difficult, to achieve a speed of motion of the interacting partners (the electrons) of more than 20% of the speed of light, which makes the application of the FPSIF-theory, extremely efficient. And also the installation of cyclic periodical circular trajectory (for the electrons) is no problem, because the electrons can be guided (due to their very small rest mass) very easy by a moderate magnetic field. The formula for the calculation of the radius of such a circular trajectory, is to be found also in the classical beginner's literature, according to equation (19):

$$r = \frac{m \cdot v}{q \cdot B}, \qquad (19)$$

with B being the magnetic induction in accordance to the applied magnetic field ($B=\mu_0 \cdot H$). If we put B=0.01 Tesla into this formula, together with a velocity of the electrons of $v = 21.28\%\,\mathrm{c}$, the diameter of the circular trajectory of the electrons will be 7.43 centimeters, whereas the diameter can be adjusted to technical requirements (of an engine) very easy, by a variation of the field strength of the applied magnetic field, which is responsible to deliver the centripetal-force, to keep the electrons on their circular trajectory.

On this basis, it should be possible to develop electron-beam tubes, which can convert zero point energy from the quantum-vacuum very efficient.

Of course we need not only an electron-beam, but we additionally need a technical facility, which extracts energy from the electron-beam. The electrons are accelerated by the zero point energy of the quantum-vacuum, and we will have to find a way, to extract some kinetic energy from these accelerated electrons, and to convert it in some type of utilizable energy. If we would have only single electrons or electron-clusters (staying together), we could make the electron-beam pass some coils, so that each

electron or each electron-cluster represents a time-dependent electrical current passing the coil, causing of course an induced electric voltage in the coil. But reality is different, because in reality, we have a continuous electron-beam, because different from single flying electrons or electron-clusters, it is rather easy, to organize and realize a continuous beam. A continuous beam however, is a direct current, and a direct current will not induce any voltage in a coil. This means, that we have to find some different means, to extract energy from the electrons being accelerated by the energy of the quantum-vacuum. A possible imaginable means for this purpose, is the setup of a very special rotor with negative electrical charge on its surface, as for instance drawn in the sketch of Fig.14.

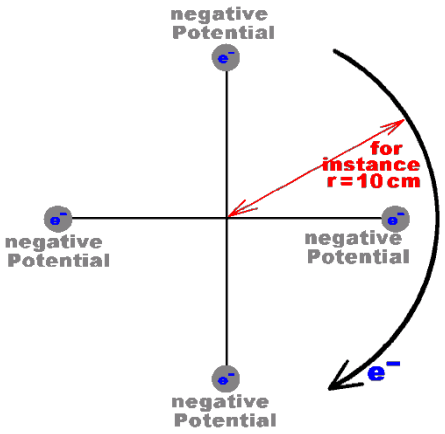


Fig. 14:

Rotor, consisting of several leverage-arms with spheres (or other surfaces) at the end of the arms, which carry negative electrical charge. An electron-beam surrounds concentrically the centre of the rotor, so that it passes by at the electrically negatively charged spheres, in not too large distance.

The electrically charged spheres (or other shapes) have the purpose to keep many electrons together like clusters.

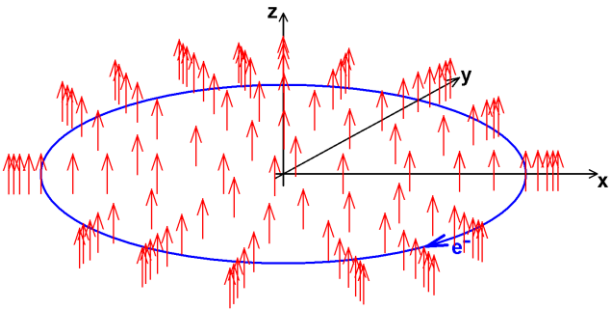
According to the FPSIF-principle, the electrons in the electron-beam, are being accelerated at each passage of each electrically charged sphere, and in the same manner, the electrically charged spheres are accelerated into the opposite direction (following Newton's "actio=reaction", even with delay due to the FPSIF-principle), so that the electrostatic rotor begins to spin, and the electrons in the beam are being accelerated at the same time. The energy-supply for the acceleration of both sides (spheres as well as electrons) is coming from the quantum-vacuum. One of the advantages of this type of zero-point-energy converters is, that it does not need high speed of mechanical parts, and it does not require any speed of any mechanical parts at all, for being started. But it can be started very convenient, with the use of a classical electron-source, emitting a standard electron beam.

For technical reasons, namely in order to avoid, that the electrons of the beam drift apart, and additionally in order to avoid, that the radius of the circular electron trajectory is enhancing as a function of time, due to the acceleration of the electrons within the beam, it will be necessary to develop appropriate elements for the proper guidance of the electron beam:

It could be for instance an idea, to bring the electrons on helical trajectories, in order to avoid that they can fly away. These words shall express, that there is an "ideal circular trajectory with the required radius". All electrons which fly on a trajectory with a radius smaller than the ideal required radius shall feel a centripetal force, which is too small to keep the radius constant, and this is achieved by exposing the space inside the "ideal circular trajectory with the required radius" to a magnetic field which is too week to keep the trajectory's radius constant, so that the real radius of the trajectory is being enhanced due to the too weak magnetic field. In the opposite manner, all electrons which fly on a trajectory too large compared with the "ideal circular trajectory with the required radius", are exposed to a magnetic field, which is "too strong", so that the centripetal force, is too strong to keep the radius constant, so that the radius of the electron's trajectories is being decreased down to the value of the "ideal circular trajectory with the required radius".

This could perhaps be realized with an inhomogeneous magnetic field, which has stronger field strength at this very space, where the electron-beam shall be compressed (in radius), and a weaker field strength at this very space, where the electron-beam can be allowed to expand in radius. This can bring the electrons always back to trajectories with a predefined desired value of its circular radius. This is illustrated in Fig.15. Electrons, flying along almost circular but imperfect trajectories, can enter a region of too small radius of their circular trajectories, and there they find a reduced magnetic field, so that the radius of their circular trajectories will be enhanced (i.e. corrected), whereas electrons, which come into

a region of circular trajectories with too large radius, find an enhanced magnetic fields there, so that the radius of their trajectories is being corrected be being reduced, back to its optimum value.



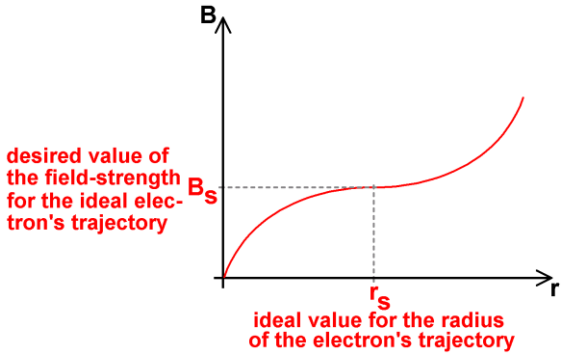


Fig.15:

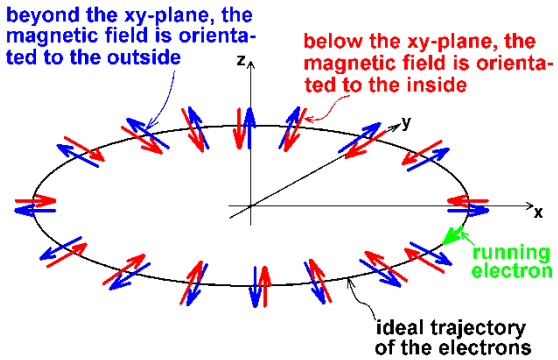
15.a, first part:

Electrons flying in the xy-plane on the circular trajectory around the z-axis. Along of the optimum trajectory with ideal radius, the field-strength of the magnetic field (see arrows in z-direction), responsible for the centripetal-force, is kept constant. But as soon as an electron loses its optimum trajectory, it feels reduced field strength, if it comes to a radius smaller than the optimum value, so that the radius of the trajectory is brought back to its optimum value. But on the other hand, if the electron comes to a radius which is too large, it feels an enhanced field-strength, so that its trajectory-radius is reduced to down to its optimum value. (The density of the arrows, symbolizing the field, represents the field-strength of the z-component of the magnetic-field.)

15.b, second part:

Absolute value of the z-component of the magnetic field, responsible for the guidance of the electron-beam, as a function of the distance “r” from the z-axis. This field shall have the purpose, to avoid that the electron-beam will drift apart, in radial direction.

Such a magnetic field might be a possible instrument, to guide the electron-beam within the xy-plane (see Fig.15), so that the electrons will not push off (too far) from their circular trajectories. The guidance of the electron-beam in z-direction, could be managed in principle in rather analogous manner (see Fig.16), for instance by a applying directly within the xy-plane, where the electrons shall run, absolutely no magnetic field and no electrostatic field, but above and below the xy-plane, there should be a magnetic field and/or an electrostatic field, which guides the electrons back into the xy-plane. This could for instance be a radially orientated magnetic field, of which the field-strength increases directly with the distance from the xy-plane (see Fig.16). Alternatively, it would be imaginable, to install an electrostatic field with appropriate geometry of its field flux lines, guiding also those electrons back to the xy-plane, which leave their ideal position, having a z-coordinate of z=0.



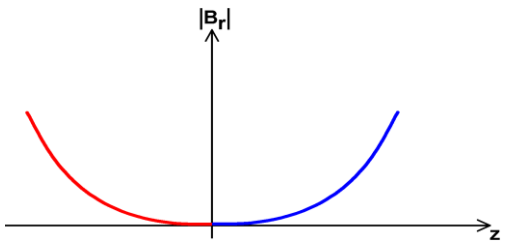


Fig.16:

16.a, first part:

Electrons flying in the xy-plane along a circular trajectory around the z-axis. A deviation of the electron trajectory into the z-direction (away from the xy-plane), can be avoided by a magnetic field which creates Lorentz-forces to the electrons, where these Lorentz-forces must point into positive z-direction, for electrons being located at negative z-position and the Lorentz-forces must point into negative z-direction, for those electrons, which are flying at positive z-position.

16.b, second part:

This part of Fig. 16 displays an imaginable radial component of the magnetic field (drawn in blue and in red colour), which has the purpose to avoid, that the electrons of the beam will diverge, away from each other into the z-direction.

This could be a possible field geometry for the guidance of the electron trajectories (i.e. the electron beam) along a circular trajectory within the xy-plane (see Fig.15 and Fig.16).

A very easy realizable alternative for the same purpose, could also be a component of a magnetic field according to Fig. 15, together with a superposed electrostatic field according to Fig. 17. The last mentioned electrostatic field, for the collimation of the electron-beam within the xy-plane, can be for instance realized, by a capacitor, consisting of two parallel plates, which are both negatively electrically charged. At the same time, the middle between the both capacitor plates, which is the xy-plane, shall be grounded, so that electrons, which deviate from the xy-plane to the top or to the bottom, experience a repulsive force from this capacitor plate, to which they come more close, and this repulsive force will drive them back to the xy-plane (to the middle of the capacitor).

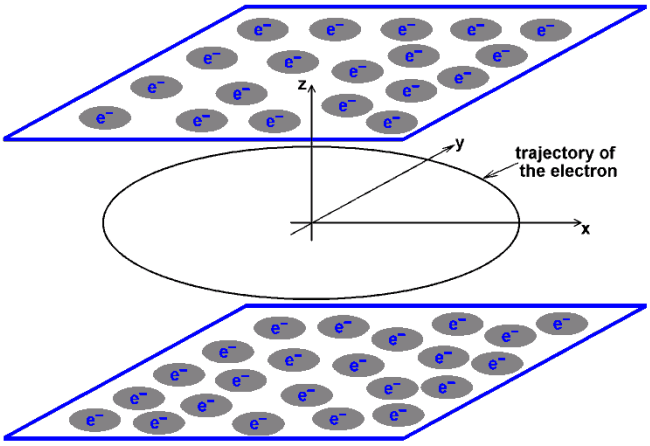


Fig.17:

Also two negatively electrically charged capacitor plates can be suitable for the guidance of the electrons in the xy-plane. But those both capacitor plates must be charged electrically more negative, than those components (spheres) of the rotor, according to Fig.14, because these components of the rotor according to Fig.14 have to be more close to ground than the capacitor plates. These rotor-components have not only the task, to fulfill the FPSIF-principle, but they additionally also represent the grounding of the middle of the capacitor.

Of course, also totally different types of field-geometries are imaginable, sensible and possible, consisting of several electrostatic and magnetic fields. Their purpose is not only to avoid that the electron-beam drifts away or apart, and to keep the electron-beam in small distances to the ideal positions, but they also have to fulfill the necessities of the FPSIF-principle.

Also helpful against the risk, that the electron beam might drift apart or away, can be the idea, to replace the spheres of Fig.14 (which are responsible for the conversion of zero point energy according to the FPSIF-principle), by some of other components with different shape. In Fig.18 this idea is illustrated, by replacing the spheres by torus-rings, making the electrons fly through the middle of these torus-rings.

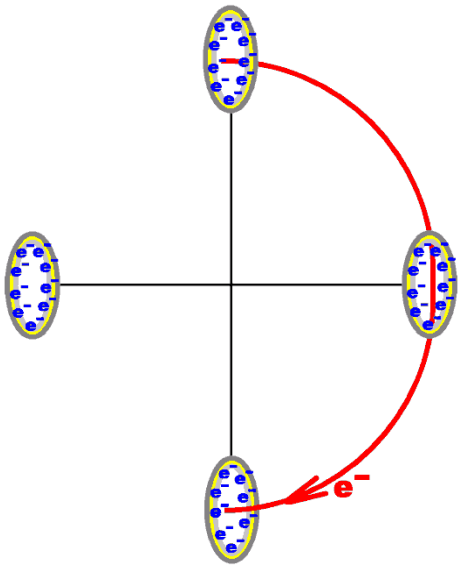


Fig.18:

Electron-beam (in red colour), which flies through the middle of some engine-components (as for instance torus-rings, drawn in yellow and gray colour), carrying electrostatic charge-carriers (drawn in blue colour).

A classical numerical example allows us, to estimate the order of magnitude of the dimensions, of an EEDR-converter:

● An electron, which is flying with about 20% of the speed of light, along a circlular trajectory with a diameter of about $r = 5cm$, makes approximately $1.91 \cdot 10^9 \text{rounds/second}$. This corresponds to a circular current of $1.6 \cdot 10^{-19} C \cdot 1.91 \cdot 10^9 s^{-1} \approx 3 \cdot 10^{-10} A$.

● The Coulomb-force between one electron and one electrically negatively charged sphere or torus (mounted on one rotor-blade), can be estimated, by the numerical example of a sphere with 1 mm of diameter and an electrical potential of 10 kilovolts (relatively to ground), so that the sphere (or torus) carries an electrical charge of 10^{-10} Coulomb. At a distance of 1 mm between the centre of the sphere, and the electron passing by, the Coulomb-force between the electron and the sphere (according to the generally known equation (20)), is being expected at an order of magnitude of about F = 10^{-14} Newtons.

$$F = \frac{1}{4\pi\varepsilon_0} \cdot \frac{q_1 \cdot q_2}{r^2} \qquad (with\ q_1 \approx 10^{-10} C\ \ and\ \ q_2 \approx 1.6 \cdot 10^{-19} C) \tag{20}$$

● Because of the number of rounds per second, which the electron makes on its circular trajectory, the duration, during which the Coulomb-force is active according to equation (20), can be estimated to be in the order of magnitude of about $dt \approx 10^{-10}$ seconds, so that the transfer of momentum, per each passage of one electron at one sphere, is to be expected in the order of magnitude of about $dp = F \cdot dt \approx 10^{-24} N \cdot s = 10^{-24} kg \frac{m}{s}$, and the momentum is being transferred 10^{10} times per second.

● Now we shall not forget, that the electron undergoes two phases within one passage, relatively to each single electrically charged sphere of the rotor. Thus, according to the FPSIF-principle, we cannot bring the complete momentum-transfer (as calculated above) into account, but only the percentage of the momentum-transfer-difference between the ingoing part of the electron's flight and the outgoing part of the electron's flight. Let us assume (pessimistically, i.e. cautious, without calculation), that this momentum-transfer-difference should be about 1/10 (i.e. 10%) of the total momentum transfer (which is really very cautious, if we have in mind, that the electron's speed is about 20% of the speed of light), then we have per each second and per each electron (and per each sphere) a gain of momentum of about $\Delta p = dp \cdot 10^{10} \cdot 10\% = 10^{-24} kg \frac{m}{s} \cdot 10^{10} \cdot 10^{-1} = 10^{-15} kg \frac{m}{s}$.

● Let us run an electron-beam with 1 Ampere. With a current (as estimated above) of $3 \cdot 10^{-10} A$ per each electron, this beam consists of about $3 \cdot 10^{+9}$ electrons. This indicates, that we gain a momentum per each second of time of approximately $\Delta P = \Delta p \cdot 3 \cdot 10^9 = 10^{-15} kg \frac{m}{s} \cdot 3 \cdot 10^9 = 3 \cdot 10^{-6} kg \frac{m}{s}$.

● If the rotor consists of four rotor blades, we have four times this momentum for the complete rotor, and thus we come to a gain of momentum per each second of time of about $10^{-5} kg \frac{m}{s}$.

● If the rotor has an inertial mass of about one metric Gramm, the rotor experiences an acceleration of about $a = \frac{\Delta P}{m} \cdot \Delta t = \frac{10^{-5} kg \frac{m}{s}}{10^{-3} kg} \cdot 1s = 10^{-2} \frac{m}{s^2}$.

The advantage of the EEDR-conception is, that the force accelerating the electrons as well as the rotor, remains existent (it is enhanced in fact) for a high angular velocity of the rotor. For the kinetic energy increases with the square of the velocity (E=½mv²), it is possible to optimize the field of operation of the engine, if the angular velocity of the rotor is chosen not to slow.

● In literature, we can find typical technical data of electron guns (see for instance [Wik 13b]), and we see, that normal classical standard electron guns, can produce a power density for instance in the range of up to 10^7 W/cm². So we see, that the above estimated power of the system (with an electrical current of 1 Ampère) can be enhanced by several orders of magnitude, and with it the power-density of the system. This can be seen as following: The power-density of the electron-beam, as estimated above, is in the range of $\frac{P}{A} = \frac{12000V \cdot 1A}{(5mm)^2} \approx 5 \cdot 10^4 \frac{Watt}{mm^2}$. This can be enhanced remarkably (also when we use a classical standard electron gun) to inject more and more electrons during time, into the circular beam of the

EEDR. By this means the value of 10^7 W/cm² for the power density of the beam can be exceeded considerably. Several orders of magnitude enhancement of the electrical current, has the consequence of several orders of magnitude enhancement in the acceleration of the rotor, and accordingly several orders of magnitude enhancement of the power being converted from the quantum-vacuum.

● This is of course not an exact calculation, but only an estimation of the orders of magnitude of the power-density of the EEDR. But: Important is, that the angular velocity of the rotor (made of real existing material), does not play a role with regard to the power being converted from the quantum-vacuum. It is a "motionless-converter" which starts operation even before any material components are in motion. It can start from the standstill (of the rotor); and small units with the size of few centimetres can work properly, according to the expectations from the FPSIF-theory.

● For sure, there will be many possibilities to enhance the operating efficiency of the EEDR-system tremendously. Not only the geometrical dimensions, the number of the rotor-blades, the shape of the rotor-blades, but also the geometry of the electrical and the magnetic fields, will provide a lot of potential for many optimizations of the EEDR.

● If the molecules of the air, surrounding the rotor, disturb the operation of the EEDR, the whole system can be built up in an evacuated tube, similar like the glass-tubes, which Nikola Tesla used for his ZPE-energy-converter, as being reported by Jebens [Jeb 06].

● Furthermore important, will be the control of the velocity of the electrons. Not only the rotor, with its electrically negative charged spheres or torus-rings (or other elements), will be accelerated from the energy of the quantum-vacuum, but also the electrons within the electron-beam. According to equation (19), the radius of the circular trajectory of the electron-beam, increases linearly with the speed of the electrons, so that during time, the electrons will not follow a circular trajectory, but they will follow a helical trajectory (with increasing distance from the centre). And this type of helical geometry of the trajectory cannot be made circular by a special geometry of the fields, as it had been described above for a different purpose, namely for the purpose to avoid any divergence of the electron-beam, or which the the electron-beam is passing by. What we need, is a permanent extraction of energy from the electron-beam, as it could be for instance done with appropriate coils, through which the electron-beam is flying. Also different other techniques and procedures will have to be developed, for the purpose to extract permanently energy from the electron-beam, and to keep the electron speed (more or less) constant by some means. A possible method for the extraction of energy from the electron-beam, can also be a different choice of the basic geometry of the EEDR, as it will be presented in the following section 5.2.

5.2. Other types of EEDR-Geometry

The control of the maximum velocity of the electrons in motion, will be especially easy, if we bring these elementary particles into oscillation (not rotation), within an electrostatic (Coulomb-) potential, according to Fig.19. The most important aspect of this potential is the fact, that it has a minimum in the geometrical middle of the space, in which the electrons will have to oscillate.

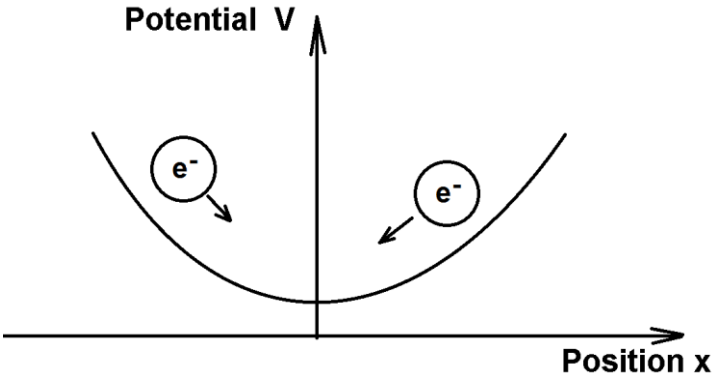


Fig.19:

Two electrons, which oscillate (back and forth) within an electrostatic (Coulomb-) potential.

In a static potential like this, the electrons always fly alternating towards each other and away from each other – in analogy to the motion of the magnets at the MMDR-converter. This motion of the electrons also fulfills the preconditions for ZPE-energy-conversion according to FPSIF-theory. The advantage of such motion (with its trajectories) is, that the more energy the electrons have, the more close they come to the capacitor plates at the outside of the capacitor (see Fig.20), where they turn back the direction of their flight. This means, that those electrons with larger amount of energy, come to positions which will not be reached by such electrons, with less amount of energy. Thus, we can mount a coil at the "outside", i.e. at those positions, to which only the high-energy-electrons come, so that the coil extracts energy selectively, only from the high-energy-electrons. The positions, at which we mount the coils for energy extraction, define the threshold of energy, at which we begin to extract energy from the electrons.

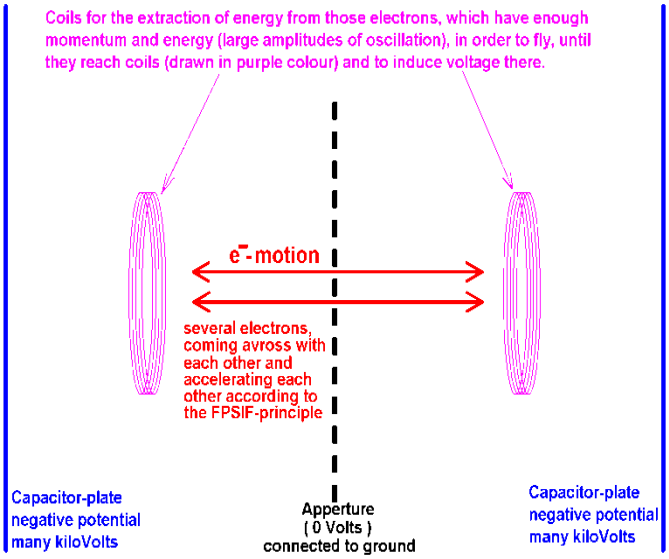


Fig.20:

Electrons, which fly along oscillating trajectories, back and forth, within a special capacitor, being made of three plates (two plates in blue colour at the outside and one "aperture" in the middle). The potential of this capacitor follows the requirements of Fig.19, i.e. the value of the potential has a minimum in the "middle" and is larger "outside".

At the outside, we have coils, which extract energy from those electrons, which oscillate with amplitudes larger than a predefined threshold, because these energy-rich electrons induce electrical impulses into the coils. These electrical impulses can be supplied to an arbitrary user.

In order to avoid any divergence of the electron-beam, it would be possible, to construct appropriate configurations of a magnetic field (please compare section 5.2) or to apply some special geometry of electrical fields. The last mentioned version could be realized perhaps with several capacitor plates (as for instance being visualized in Fig.21), whereupon the capacitor plates might be bent, if some special three-dimensional shapes will turn out to be advantageous.

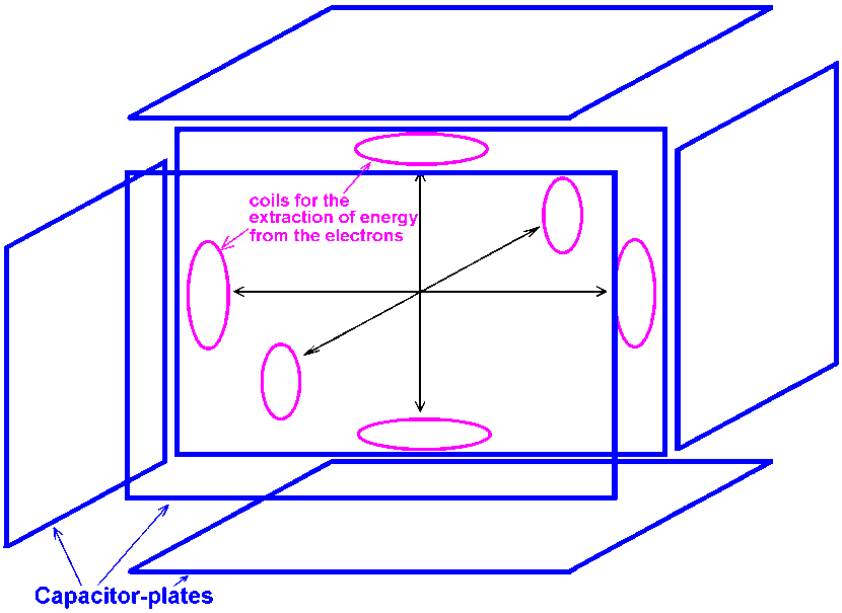


Fig.21:

Example for a possible capacitor-geometry for the three-dimensional control of electron trajectories along three-dimensional oscillations (Lissajous-figures).

5.3. The crystal-cell: A classical system with economic potential

In principle, the crystal-cell is a simple battery, but several people discuss it as a candidate for zero-point-energy conversion. In fact it is an absolutely open question up to now, whether the crystal-cell works on classical electrochemical reactions, or whether a connection with the zero-point-energy of the quantum-vacuum is existing. The configuration should normally indicate to the first mentioned point of view, the classical one, but the very large energy-density (which is larger than the energy-density of gasoline) puts a lot of questions to this classical point of view, as we will discuss soon in the course of section 5.3.

Without any discussion (absolutely clear) is the fact, that the crystal-cell is an extremely low-cost source of energy, which can produce electrical energy much cheaper, than the price we are used to in our days. Consequently we have to discuss in connection with the crystal-cell, not only technical aspects, but also (and mainly) economical aspects.

Basic facts:

Electrochemical contact voltage, is a well known phenomenon in the disciplines of electrical engineering and electrochemistry [Wik 13c]. This voltage is typically tapped, by bringing two electrodes made of different metal, into contact with an electrolyte (often in liquid phase).

Widely known is also the fact, that it is sensible to make one electrode from aluminum and the other one from copper, in order to get a good voltage. Less widespread is the information about the possibility, to make the electrolyte extremely price-efficient from vinegar as immersion in burnt lime. A small amount of graphite powder can be added, according to an information which is empirically bequeathed by practicians [Har 12]. The mixture for the recipe of the electrolyte, passed on by Guy Hary, was the following:

- One volume-unit of burnt lime (calcium carbonate)
- One tenth of volume-unit of vinegar
- One twentieth of volume-unit of graphite powder
- The whole substance shall be mixed properly with water to a homogeneous paste-like pap, which has to be brought between the copper and the aluminum.

The graphite powder enhances the conductivity of the chalk (into which it is mixed), and it can be left away if an appropriate geometrical setup is being used. In principle, an extremely simple setup is fully sufficient, as it is seen in Fig.22, where the copper-electrode is being realized as a one cent coin.

Fig.22:

Extremely simple version of a crystal-cell producing an electrical voltage of about 1.1 … 1.2 Volts.

With the setup as shown in the picture, I could produce an extremely low-cost small battery, which clearly demonstrates, how cheap energy can be.

If we want to estimate the costs of energy, with such a simple battery, we can investigate the material-prices from Internet, coming to values (at the day of 12. February 2013) of:

- Aluminum: 2102 € per metric ton, density 2.71 g/cm^3
- Copper: 6120 € per metric ton, density 2.71 g/cm^3
- Chalk (burnt lime): 2102 € per metric ton, density 2.71 g/cm^3
- Vinegar (Surrogate): 1.70 € per half a Liter

This allows a numerical example of a price-calculation with regard to the costs of raw-materials (as printed in table 3). The crystal cell, which I built up in this manner, is being seen in figure 22.

One crystal-cell, costs of raw material		
Material	Dimensions of the component	Price per component (calculated via its volume)
Copper-Electrode	0.01 mm x 10 mm x 10 mm	1mm^3 x 8.92g/cm^3 x 6120 Euro/ton => 5.46·10^{-5} €
Alu-Electrode	0.01 mm x 10 mm x 10 mm	1mm^3 x 2.7g/cm^3 x 2102 Euro/ton => 5.76·10^{-6} €
Chalk	1.00 mm x 10 mm x 10 mm	100mm^3 x 2.71g/cm^3 x 170 Euro/ton => 4.61·10^{-5} €
Vinegar (Surrogate)	roughly 1/100 of the chalk	2 µltr. x 3.40 €/ltr => 6.80·10^{-6} €
Water	Negligible low in price	
Table 3: Price calculation of a small crystal-cell		

In order to obtain the energy-price, the costs for the production of the crystal-cell must be compared with the amount of electrical energy being supplied, which we determine as the energy, equal to the power multiplied with the time. This comparison will allow us, to interprete the result with sense.

Therefore we need a measurement of the electrical power. For this purpose, I built up 12 crystal-cells, as shown in Fig.23. It is a series connection. The setup is geometrically somehow larger, than the example-calculation of table 3, but the optimization of the geometrical dimensions is by far not yet done. After the experimental investigations done up to now, it appears absolutely realistic, to get an electrical power as written below, with a material-effort according to table 3.

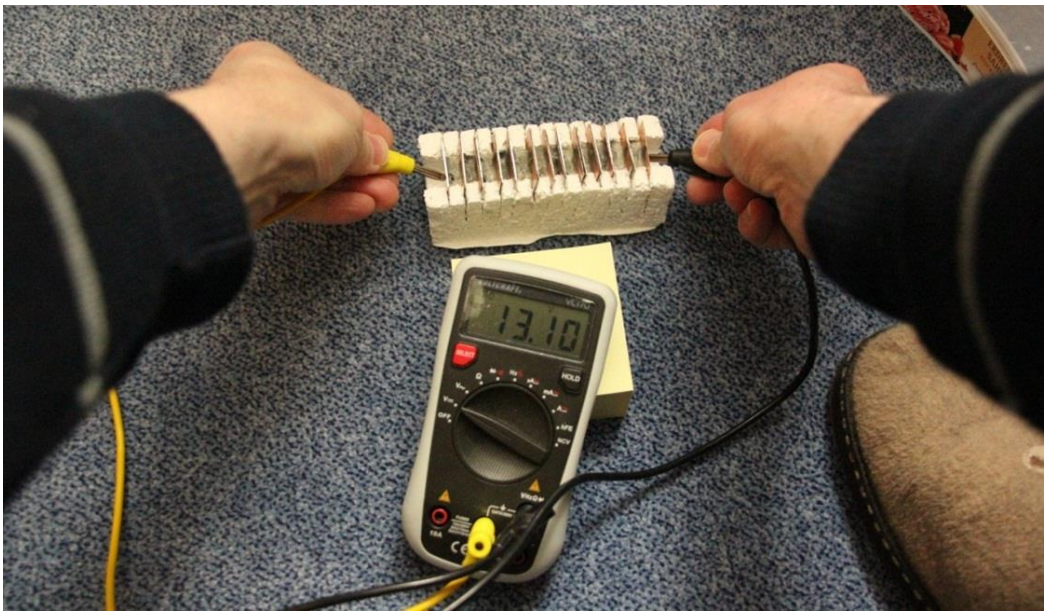


Fig.23:

The manufacturing procedure of such a simple crystal-cell in series-connection, took me about one and a half hours.

As can be seen, the crystal-cell produces a voltage of about 13 Volts.

Electrical power was being extracted with a consumer-resistor of 100 KΩ (where the value of the resistor was adjusted to the maximum of power-output), so that the power could be measured with a Voltmeter and an Amperemeter – leading to the following values:

$$\left.\begin{array}{l} U = 5.0V \\ I = 50\mu A \end{array}\right\} \Rightarrow P = 250\mu Watts$$

If each single cell delivers a power of nearly 21µW, then we can insert a rounded value of about 20µW per each single crystal-cell, and calculate its price as (compare table 3):

$$5.46 \cdot 10^{-5}\,€ + 5.76 \cdot 10^{-6}\,€ + 4.61 \cdot 10^{-5}\,€ + 6.80 \cdot 10^{-6}\,€ = 1.13 \cdot 10^{-4}\,€$$

We scale this up, by six orders of magnitude, and come to a tremendously large crystal-cell, delivering about 20 Watts (or 1 million of small crystal-cells, which have about 20 Watts altogether) for a price of

$$5.46 \cdot 10^{+1}\,€ + 5.76 \cdot 10^{0}\,€ + 4.61 \cdot 10^{+1}\,€ + 6.80 \cdot 10^{0}\,€ \approx 113.-\,€$$

This amount of power can be extracted for a minimum of at least 10 years (probably longer, according to the experience of [Har 12] and of [Rei 11/12]), because we know, that crystal-cells had been working stable for many years, for sure since more than 10 years, maintenance-free. This allows us, to calculate a minimum estimation of the total energy within the crystal-cell, which we will give in KiloWattHours (kWh), so that we finally come to the maximum price per kWh. If the economic lifetime of the crystal-cells will be longer than expected, the price per kWh will be less than what we calculate. The uncertainty in the value of the lifetime has the reason, that the crystal-cells, which had been built many years ago, are still under proper operation, and nobody knows, at which day they will stop their operation. So, this is our cautious energy-price calculation:

20 Watts · 10 years · 365 days/year · 24 hours/day = 1752 kWh
The rule of proportion delivers: 1752 kWh cost approx. 113.- €
=> 1 kWh cost approx. 113/1752 € ≈ 6.45 cent

In view of the fact, that there has been almost no optimization of the geometry at all, it should not be a serious problem at all, to reduce the amount of necessary material remarkably, perhaps by a full order of magnitude or much more. This will reduce the price of the electrical energy to the same amount, as the inserted material – no matter, whether the crystal-cell is a classical electrochemical source of energy, or whether it has some connection to the zero-point-energy of the quantum-vacuum.

Additionally, it would be imaginable, not only to optimize the geometry of the dimensions (the amount of the copper and chalk) to be inserted, but also to try different materials, in order to find the lowest possible energy price. So, if we for instance come to an energy price of 0.5 … 1.0 Cent per kWh (for the material), we will have to add the costs for fabrication, but in view of the tremendously large lot sizes and numbers of pieces being necessary, the costs for fabrication are usually not higher, than the costs for the material.

Finally, we can conclude, that the crystal-cell is a very simple system, to produce electrical energy rather inexpensive (of course not as cheap as the MMDR !), but the crystal-cell has the disadvantage of very unhandy dimensions. Via parallel- and series- circuitry, we can connect many many crystal-cells with each other, in order to deliver the electrical energy in a way as we like it (for applications), so that we just can calculate the volume of material per kWh:

The crystal cell according to table 3 has a volume of 1.02 mm x 10 mm x 10 mm, and we should add a housing. If we fabricate the housing from plastic, for instance 0.5 mm thick (cheap plastic, as it is used for instance for yoghurt cups, we come to a specific volume (= volume per kWh) of

1.02 mm x 11 mm x 11 mm = 123.42 mm^3 for 21 µWatts

Upscaling in power and volume by 6 orders of magnitude, leads to multiplication of length, wideness and height, each of these dimensions by a factor of 100:

10.2 cm x 110 cm x 110 cm = 123.42 Liters für 21 Watts

A typical house for a family (as usual in the home country of the author) needs a power-supply of about 5-10 Kilowatts. Let us assume for instance 8.4 Kilowatt (which should be rather much), then we need about 400 such units of 123.42 Liters, this is a volume of 49.4 cubic metres. This is a rather large amount of material, which could be arranged for instance as following: 3.00 Meters x 3.00 Meters x 5.50 Meters. This is a block which can be localized in the cellar, or besides to the house. If I would have to do this for my house, I would put half of the block (or more) into the soil, as drawn in Fig.24.

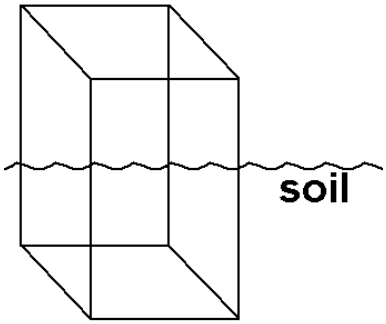


Fig.24:

A crystal-cell, how it could ensure the energy supply for a house, could be located in a little cabin in the garden with a base area of 3 Meters x 3 Meters and a height of 2 Meters or 2.50 Meters over the soil. Or the energy supply could be located in the cellar. The economic lifetime is minimum 10-20 years.

With 113 € per 20 Watts, we come to an energy price of 47460.- € per 8.4 kiloWatts (perhaps additional manufacturing costs) for more than 10 years. In many countries, this is a very favourable energy price. Because it is to expect, that and optimization of the geometry and of the materials, will further reduce the price by a factor of 5 or 10, or even more, it should be expected that 8.4 kiloWatts can be produced for 10 years or longer, for a total overall price of about 5000 … 10000 Euros. This is in the most of the countries on our earth a very good energy price. And it is free of maintenance, and without any problems to health.

This is in principle a way, how energy-supply can be made efficient, even without clarifying the question, whether the zero-point-energy of the quantum-vacuum plays a role or not. The expenses for the development are rather moderate, and the system is verified in small units: To be done is a manageable optimization of the geometry of the crystal-cells.

The energy density gives cause for serious considerations:

If we calculate the energy-density of the crystal-cells, we come to surprisingly large values. Let us take the numerical figures from the above calculation:

123.42 Liters for 21 Watts, over 15 years = 15 · 365.25 · 24 hours = 131490 hours

This leads us to a total energy within the crystal-cell of:
123.42 Liters for 21 Watts · 131490 hours = 2761290 Wh

Thus, the energy-density of the crystal-cell is 2761290 Wh / 123.42 Liters = 22373 Wh/ltr.

This is far too much, than we can ever expect from classical batteries. The batteries with the largest energy-density today, have about 400 Wh/ltr. These are zinc-air-batteries [Var 10]. The most modern Lithium-Ion-accumulators reach about 500 Wh/ltr [Wik 13d]. Gazoline is known for its extremely high energy-density with about 20000 Wh/ltr.

This means, that the energy-density of our crystal-cell is larger than the energy-density of gasoline – if it produces electricity for more than 15 years, even remarkably larger. And if an optimization of the geometry can be performed successfully, the energy-density of the crystal-cell can be still larger than the values estimated here. This does not really match to our imagination of electrolysis, and it arises again questions about an unknown source of energy. In any case, this is a clear indication, that the system of the crystal-cell will have to be included into a scientific program for clean alternative energy-sources, although the theoretical aspects about its working-principle are not clear.

Further comparison of prices:
As can be seen in the following lines, in comparision with typical ZPE-energy-systems, the crystal-cell is a rather expensive energy-source. For comparison, we check a price-estimation of a MMDR-converter system:
The magnetic disk of a MMDR-motor according to line 6 in table 2 contains 28 magnets. If we use very large cylindrical magnets with a holding-force of 640 Newtons (which is an extremely cautious estimation, because the force is 8 times as strong as we assumed in the computer-simulation, on which table 2 is based), we find a price of 28 Euros per each magnet [Sup 13]. Using two disks with 28 magnets per each, and thus we come to a price of:

2 disks · 28 magnets · 28 € per each magnet = 1568 € for the magnets.

This is the dominant part of the price of the MMDR-converter. The rotating disks with the bearings are for sure less expensive than half of the price of the magnets. Let us take into account the costs for the break/retarder-system with electronical control (electronic circuits are not very expensive nowadays), then we can assume, that the total MMDR-device is cheaper than 3000 € in line-production with large lot-sizes.

This price can be interpreted in comparison with the amount of energy being produced. The angular-velocity can be enhanced relatively to line 6 in table 2, and the holding-force of the magnet (of the price-estimation) is nearly a full order of magnitude larger than in our computer-simulation of the power-computation. Thus the power-output will for sure larger than 2 kW, and in order to estimate the price with a maximum of safety, we assume a power-output of 2 kW. This will lead us to a total amount of energy being produced with one unit of an MMDR-converter:

produced energy = 2kW · 24 hours · 365 days · 30 years = 525600 kWh

This leads to an energy-price of:

1568 € / 525600 kWh = 0.57 cent/kWh

Not to forget, that this is an extremely pessimistic (cautious) price-evaluation !
In the price-estimation, the magnets are chosen remarkably stronger, than in the technical computer-simulation, and the angular-velocity can be enhanced remarkably, with regard to the technical computer-simulation. With those and several other parameters, the power-output of the MMDR-converter will be expected to be larger than estimated in our cautious price-estimation. Thus a power-enhancement of a factor of 5…10 is realistic (at constant price), so that the energy-price might be expected to be reduced even by a factor of 5…10, relatively to our extremely cautious price-estimation. Thus, it is indeed realistic, to get an energy-price below one tenth of a cent/kWh with the MMDR-converter.

In reality, the rather expensive rare-earth super-magnets, used in our price-estimation can be replaced by cheap standard-material magnets, which could allow us to reduce the energy-price of the MMDR-converter even further.

5.4. Electrolysis, perhaps possible in „over-unity“ ?

Among non-corporate zero-point-energy working-groups, there is often a discussion about the possibility of an “over-unity” electrolysis. Some people speak about investigations, but I did not find serious reliable references in literature, which are 100% for sure. In order to think about this topic, I decided to manufacture a simple electrolysis-cell by myself in December 2011, by bending a stainless steel panel from an old washing-machine into an undulated shape (by the use of a gaspipe pliers). By this means, I got two electrodes, which I fixed into a water-bucket, so that I was able to perform an electrolysis with this very simple setup. On the top of the arrangement, over the electrodes, I mounted a receptacle to collect the produced electrolytic oxyhydrogen gas. On the highest point of the receptacle, I mounted a test-tube of glass, so that I could count the volume of gas being collected (see Fig.25).

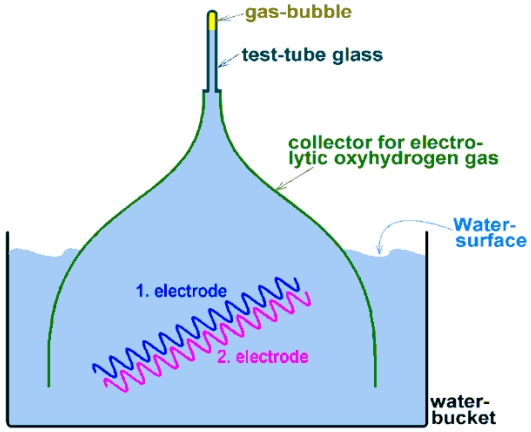


Fig. 25:
Electrolysis-cell with contrivance for the collection of the produced electrolytic oxyhydrogen gas.

The coefficient of performance (COP) of the electrolysis can be determined very easy, by comparing the electrical energy-input (equation 21) with the volume of the produced electrolytic oxyhydrogen gas – its energy density is written in (equation 22)).

$$E_{\text{electrically}} = \int U(t) \cdot I(t)\, dt \tag{21}$$

$$\frac{E_{\text{oxyhydrogen-gas}}}{V} = 8.506 \frac{J}{cm^3} \quad \text{[Hol 76]} \tag{22}$$

Absolutely without any optimizing of the setup, I determined the COP of this electrolysis configuration, being supplied with direct current, namely from a direct current power supply as it is normally used to charge accumulators. The COP was approx. 9%. With regard to the fact, that this setup does not have any systematic background, this value neither “large” nor “small”, but this just to be regarded as a label for calibration of the very simply setup under DC-operation.

The next step was, that I connected a signal-generator, producing rectangle signals, namely pulses as shown in Fig.26, to the electrodes. The data evaluation of the electrical energy (according to equation 21) was done with an oscilloscope.

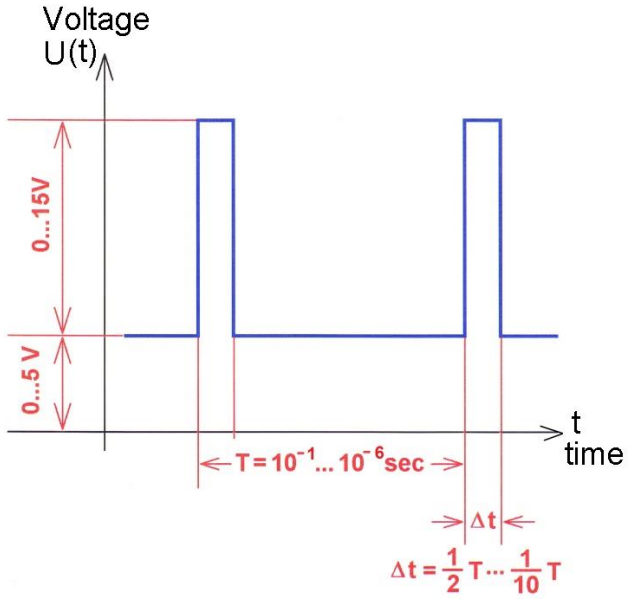


Fig. 26:
Signal shape of the electrical signal for the supply of the electrodes in pulsed electrolysis.
A voltage-offset can be controlled between 0 Volt and 5 Volts. On top of the offset, there is a rectangular signal with a pulse-height of 0 … 15 Volts.

I was allowed to perform these measurements as a guest at the „Physikalisch Technische Bundesanstalt” (PTB) in Braunschweig [Lie 11], see Fig.27.

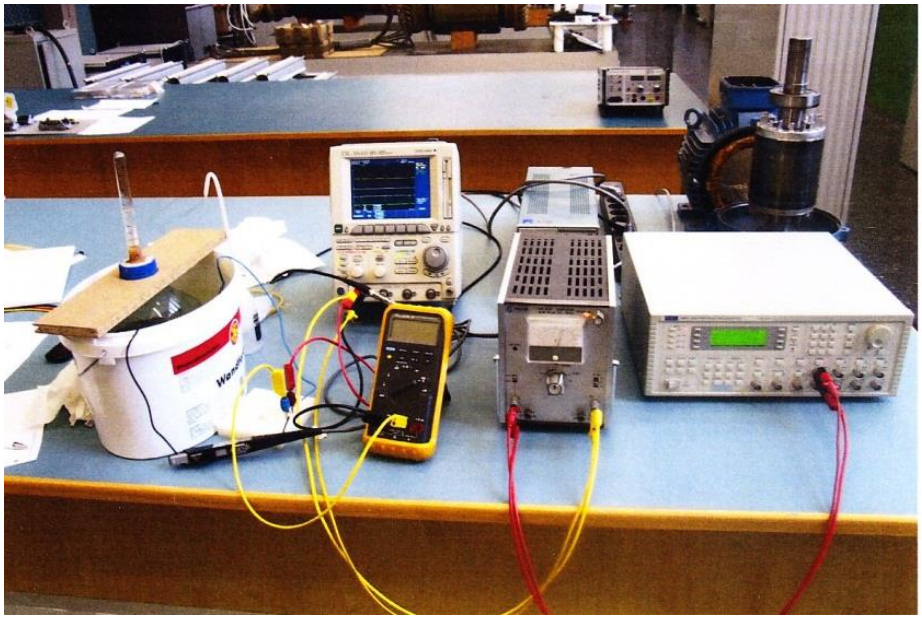


Fig. 27:
Setup for the analysis of a pulsed electrolysis. On the left side of the picture, we see the water-bucket with the electrolytic oxyhydrogen gas collector.
On the right side, besides the electrolysis-cell, we see the electronic measuring equipment with a current measuring caliper, an oscilloscope, a signal generator, and other devices.

By variation of the frequency from ZERO (direct current) up to ½ MHz, the COP was measured with the result of COP = 9% at DC-operation, up of COP = 36% at (rectangular-) pulsed operation at ½ MHz. The COP was continuously increasing with increasing frequency.

The electrical pulses split the water-molecules into ions. Important for a good COP is, that the voltage offset (the DC-component below the pulses), which is the only present component of the signal in the time between the pulses, is adjusted in such way, that the DC-component does not split any water-molecules, but the DC-voltage-component has to assure, that the ions cannot recombine during the time between the rectangular pulses. This must be controlled by the electrical current during the time between the pulses. The current must be ZERO in these intermediate time-intervals. If the current is beyond Zero during these intermediate time-intervals, there will be some DC-component of the electrolysis (with low COP). But if the current is below Zero during these intermediate time-intervals, there will be some recombination of ions, so that the energy of these ions will be lost (this energy might perhaps be converted into thermal energy). In both cases of the current being different from Zero we have some non-productive energy-consumption (not producing oxyhydrogen gas) in the system, but only in the case of the current being as exactly Zero as possible, the product of voltage multiplied with current is zero in the pauses between the pulses, and so we do not have energy consumption in the system during these intermediate time-intervals. The adjustment of the current as close as possible to Zero, is done by the means of DC-voltage offset control, in the intermediate time-intervals between the pulses.

My measurements had been checked, after I tested the principles, by a reproduction, done by a student [Rot 12]. An overview over my and his results is plotted in Fig.28. Due to the fact, that he could bring the frequency to a value a bit higher than 1 MHz, the COP could be enhanced to 40%.

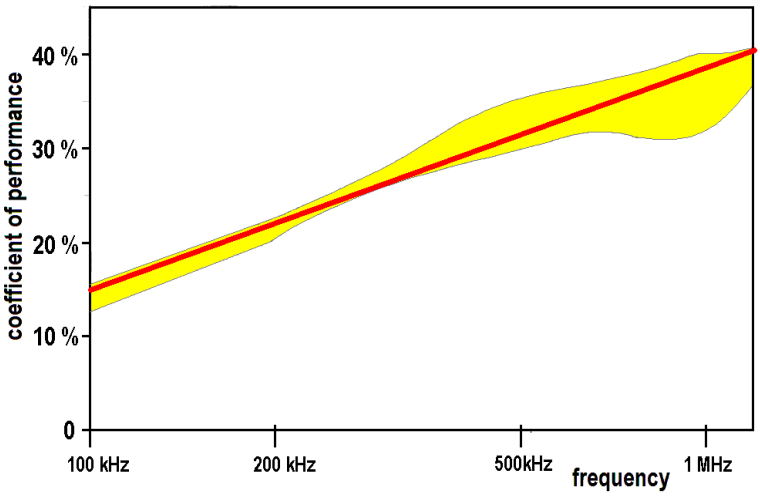


Fig. 28:
COP of an electrolysis-cell (in pulsed operation with rectangular voltage signals on top of a DC-offset) as a function of the frequency of the pulses. All points of measurement are laying with the yellow area; they are taken partwise by the author and partwise by a student [Rot 12].
Different curves within the yellow area have been taken with different "offset voltage" and different "signal height".
The red linear regression line has a slope of Δ_{COP} = 21 % per decade of frequency.

A further optimization of the pulse-pause relationship, and an optimization of the voltage for the offset as well as of the pulse-width, was performed in order to maximize the COP within the frequency of 1.2 MHz, with the result to obtain a COP up to 45% [Rot 12]. Because the data-points of the measurement, which form the yellow area in Fig.28, are taken with different values of the enumerated parameters (especially in the range of higher frequencies), and there was no complete and no systematic optimization of all the parameters within the whole parameter-set, the measured data-points are not located along one straight line, deviating from the line only by statistical fluctuations, but the measured data-points fill an extended area (as marked in yellow colour).

A further enhancement of the frequency was not possible, because I did not have a pulse-generator and an amplifier which could reach more higher frequency. Because of the fact, that the enhancement of the COP was completely linear (on logarithmic frequency scale), as it can be seen from the linear regression line in Fig.28, we can expect a further enhancement of the COP, as a function of a further enhancement of the signal's frequency. This investigation is strongly recommended for future research in any case.

Interesting would be an investigation, how far of the extrapolation of the COP as a function of the frequency can be extended to very high frequency. Up to 1.2 MHz, the COP followed fairly a linear regression line. If this linearity could be prolonged, we might develop the idea to extrapolate for instance

as following: The very last value of measurement is done with η=45% and f=1.2MHz. If we add several decades of frequency, we come to values like η=66% and f=12MHz, or to η=87% and f=120MHz, or to η=108% at f=1200MHz. In how far the frequency can be extended into such „high-frequency-range“, will be a question of electronics and of signal-supply to the electrodes. But in any case, the COP can be enhanced additionally remarkably by an optimization of the geometry of the electrodes and by an optimization of the materials – as it is well known from commercial electrolysis-cells. In our case, the COP=9% for DC-electrolysis (of my very primitive electrolysis-cell) can be replaced by a COP=60…70% under DC-operation (or even more) by the use of commercial electrolysis-cells.

An enhancement of the frequency also needs the capability to overcome the time-constants (and delay) of the electrolysis-cell, which acts like a capacitor, because it consists of two parallel metallic plates within an electrolyte. A pulse shape as drawn in Fig.29, might help to overcome this problem (this restriction), so that the electrical charge can be pressed most fast, into the capacitor of the electrolysis-cell.

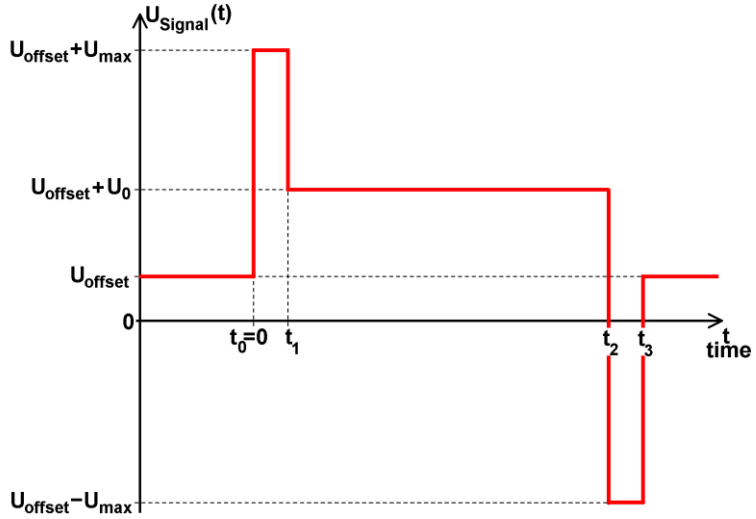


Fig. 29:

Special signal shape for the quick charging and uncharging of the electrodes of the electrolysis-cell. The image shows the signal, which the signal generator and amplifier will have to deliver, without the electrolysis-cell being connected electrically.

The offset-voltage is to be understood in principle in the same way as in Fig.24. $U_{offset}+U_0$ is the full pulse-high to split the water-molecules. $+U_{max}$ and $-U_{max}$ are very high voltage-pulses, which allow to “press” electrons into the electrodes, within a very short time, respectively to “extract” the electrons out of the electrodes, within a very short time. (The expressions of “pressing electrons” and “extracting electrons” originate from the laboratory-jargon of electrical engineers.) So if we apply for instance 100 Volts or even much more for U_{max} , the voltage will follow the usual exponential law, for the voltage of a capacitor, so that it will reach the value of $U_{offset}+U_0$ extremely fast. The “over-voltage” of U_{max} can be switched off, as soon as the voltage between the electrodes has reached the value of $U_{offset}+U_0$. In the same manner, a fast decharging of the capacitor (of the both electrodes of the electrolysis-cell) can be realized. Therefrom, we get a signal shape as shown in Fig.30, when the electrolysis-cell is attached to the signal-generator.

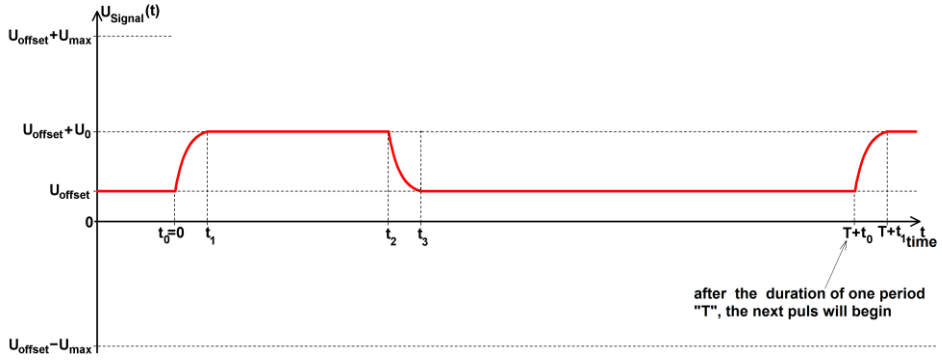


Fig. 30:
This is the way, how the electrodes of the electrolysis-cell should react to the quick-charging and quick uncharging-procedure.

The quick-charging and quick uncharging-procedure of the electrodes (of the capacitive load), according to Fig.29, can be understood as following: At the beginning of our consideration, we want to fix the time-

scale at t_0=0, where the voltage is just the voltage-offset U_{offset} , so that nothing happens at the very beginning of our consideration. At the moment t_0=0, we suggest to apply a very high voltage (+U_{max}) immediately, so that the capacitive load of the electrolysis-cell is charged exponential as usual. The exponential charging is interrupted at the t_1, when the voltage reaches U_{offset}+U_0 . At this time, the voltage between the electrodes, has the required value of the rectangular pulse, which we need for the pulsed electrolysis. We now wait and allow the voltage to stay at U_{offset}+U_0 and to spilt water-molecules into ions until the time reaches t_2 , which defines the required duration of the rectangular pulses. From the time t_2 on, we apply a high negative voltage -U_{max} , to uncharge the capacitor of the electrolysis-cell in analogous manner, as it had been charged before, this is a quick discharging-procedure.

The crucial point is, that an electric current is only running between the time t_0 and the time t_3 , but not during the long pause between t_3 and T+t_0 (and not before t_0=0). During the pause, when only the DC-offset-voltage is active, in order to avoid the recombination of the hydrogen- and oxygen- ions to water molecules, there is no electrical current, and thus no electrical input-power. During this dominant part of the time, the electrolysis-cell does not consume any electrical power, and this is the essential and important basic fact, for a good COP (and perhaps the hope for ZPE-conversion – see the following lines).

Up to now, I heard (as the author of the present article) the statement, that such a system might be brought into “over-unity”. This information is coming from several sources, but it is not really certain or reliable. Thus I feel the necessity, to verify it in the laboratory by myself. If it would be correct, it would be extremely interesting, but I should do the adequate measurements first, in order to decide whether it is correct or not. Therefore it would be necessary, to enhance the frequency into the range of many many MHz. Although I do not have the possibilities for this frequency-enhancement up to now, it seems worth trying very much, because I already could enhance the COP by a factor of five, with the pulsed operation mode, which I could realize (with rather simple means) up to now. And: The linear increase of the COP on the logarithmic frequency-scale did not come to an end, as far as I could analyze it.

And there is an additional question: How far can the COP be further enhanced, if we replace the primitive handmade electrolysis-cell by a commercial electrolysis-cell, which is optimized with regard to the material and to the geometry. Such commercial cells can be found, for instance in Internet, with a COP of 70% or even better [Stu 90] in DC-operation mode (instead of 9%, what my primitive handmade cell had had).
Which COP will be achieved, if such commercial cells will be operated in pulsed AC-mode ?
Would it be possible to come into the range of zero-point-energy conversion by this means ?
I have a theoretical explanation on basis of the electrons in the shell of the atoms (which follow the FPSIF-principle due to their motion in atomic shell) already under consideration. According to this explanation, the electrostatic field of the pulses should interate with the electrons. But I prefer to try the experiment first, before further elaborating theoretical explanations. In any case, further experimental investigations appear extremely interesting and promising. A first hint to the theoretical discussion (as mentioned) can be based on the theory of “Stochastical Electrodynamics” [Boy 66..08]: The electrons in the atomic-shell might be hit by a short pulse of an electrostatic field and thus be brought out of their trajectories, under the possibility, that the energy for the removal of the electrons is smaller than the chemical energy of the covalent binding of the hydrogen-atoms to the oxygen-atoms. The clarification of these questions should start with experimental investigations, but there is hope for interesting results.

5.5 Continuative thoughts and principles

We look to our considerations from distance, and we get the overview over the complete paper, beginning from section 1. We remember Coulomb’s law, which was written (in the original) containing static position-vectors $\vec{x}_1$, $\vec{x}_2$ of the electrical charges, which interact with each other. This is to be seen as a classical approximation, namely the static approximation, in which the time-dependency of the position vectors $\vec{x}_1(t)$ and $\vec{x}_2(t)$ has been neglected. In literature we found the retarded potentials

according to Liénard and Wiechert, and from there we face the necessity, to insert the time-dependency of the position vectors $\vec{x}_1(t)$ and $\vec{x}_2(t)$ into Coulomb's law, i.e. $\vec{x}_1(t)$ and $\vec{x}_2(t)$ are the trajectories of the both electrically charged particles, interacting with each other, as it written again in equation (23).

$$\vec{F}_C = \frac{1}{4\pi\varepsilon_0} \cdot \frac{q_1 \cdot q_2}{\left|\vec{x}_1(t) - \vec{x}_2(t)\right|^2} \cdot \frac{\vec{x}_1(t) - \vec{x}_2(t)}{\left|\vec{x}_1(t) - \vec{x}_2(t)\right|} \tag{23}$$

Obviously the Coulomb-force depends on the prehistory of the electrically charged particles, namely on their velocity of motion along their trajectories. In order to make the functional connections transparent, of all parameters interacting with each other, we want to write all parameters explicitly into equation (23), with the consequence, that it looks like equation (24). This equation (24) is not new, but it is identically with equation (23), the only difference is, that all parameters are made transparent explicitly. This is a generalization of Coulomb's law, taking the trajectories of the interacting partners (and thus also the fields) into account.

$$\vec{F}_C\left(\vec{x}_1,\vec{v}_1,\vec{x}_2,\vec{v}_2,t\right) = \frac{1}{4\pi\varepsilon_0} \cdot \frac{q_1 \cdot q_2}{\left|\vec{x}_1\left(\vec{x}_1(t),\vec{v}_1(t),t\right) - \vec{x}_2\left(\vec{x}_2(t),\vec{v}_2(t),t\right)\right|^2} \cdot \frac{\vec{x}_1\left(\vec{x}_1(t),\vec{v}_1(t),t\right) - \vec{x}_2\left(\vec{x}_2(t),\vec{v}_2(t),t\right)}{\left|\vec{x}_1\left(\vec{x}_1(t),\vec{v}_1(t),t\right) - \vec{x}_2\left(\vec{x}_2(t),\vec{v}_2(t),t\right)\right|} \tag{24}$$

And now we remember, that within classical mechanics, the trajectory of any particles is determined completely, not on the basis of their position vectors and velocity vectors only, but the complete description requires also the knowledge of the acceleration vectors.

With these words, I do not want to indicate, that it would be for sure, that the acceleration must be included in all laws of physics (for instance also in the FPSIF-theory they are not necessary), but I want to say, that it would be imaginable, that a more generalized formulation of Coulomb's law might exist, in which besides the position vectors and velocity vectors, also the acceleration-vectors can play a role. If it would be possible to find such a more generalized Coulomb's law, it might be imaginable to develop a zero-point-energy converter, which does not require the extremely large velocity, as it is necessary for the FPSIF-principle, but perhaps an acceleration of the interacting particles will help to build another type of zero-point-energy converter. This could also be a promising idea, to solve difficulties as we had them in the sections 1 – 4 (for instance with the high speed of the components of the ZPE-engine.)

If we take this idea serious, we should have to find a more generalized formulation of Coulomb's law, containing even more parameters than our equation (24), namely with dependencies like equation (25):

$$\vec{F}_C = \vec{F}_C\left(\vec{x}_1,\vec{v}_1,\vec{a}_1,\vec{x}_2,\vec{v}_2,\vec{a}_2,t\right) \tag{25}$$

- ➔ But how to find such a more generalized formulation of Coulomb's law ?
- ➔ Which considerations do we need therefore ?
- ➔ On which basic fundament can we develop such a formula ?

The answer is surprisingly much more simple than I thought before, because the solution can be found already in literature, namely for instance at Richard P. Feynman [Fey 01]. There we read on the pages 390 following (among other facts), the formula for the calculation of the electric-field of the point charge q in motion:

$$\vec{E} = \frac{q}{4\pi\varepsilon_0} \cdot \left[\frac{\vec{e}_{r'}}{\vec{r}'^2} + \frac{\vec{r}'}{c}\frac{d}{dt}\left(\frac{\vec{e}_{r'}}{\vec{r}'^2}\right) + \frac{1}{c^2}\frac{d^2}{dt^2}\vec{e}_{r'} \right] \tag{26}$$

There we have $\vec{r}'$ as the retarded distance between the "emission-point" and the "field-point". The terminus "emission-point" describes this very position, at which the charge q had been at the former moment of time t', at which the charge q emitted this very field-component, which arrives the field-sensor (being located at the "field-point"), at the moment of time t now. The point, at which the field-sensor is located to measure the field (here and now) is named with the terminus "field-point".

And the interesting crucial aspect is, that the field $\vec{E}$, which we measure at the moment of time t (now), depends not only on the position of the electrical charge q, but also on its velocity **and** on its **acceleration** along its trajectory, as a function of time. We understand this immediately, when we interpret equation (26).

- The very first summand in the rectangular bracket represents the classical form of Coulomb's law, but it contains already a first beginning of a generalization of this law, namely the view, to regard the distance between the "emission-point" and the "field-point" not in the static way (as it was done in equation (0)), but in the dynamic way of the retarded potential (according to Liénard and Wiechert). This is exactly the term, which is the fundament of the FPSIF-theory.
- The second summand in the rectangular bracket stands for the explicit consideration of the particle's velocity, because it contains the first derivative of the position-vector to time. It is to be seen in connection with the terminus of the "magnetic field" ?
- The third summand in the rectangular bracket contains the second derivative of the position-vector to time and thus, it refers directly to the acceleration of the charge q. This one is rather seldom under discussion, but it has the extremely surprising feature, that it does not decrease with the distance of the partners of interaction. This allows an interaction over tremendous distances.
- Not to be found in Feynman's formula (26) are terms containing derivatives of the position vector higher than the second. Up to now, it is not clear, whether there might occur such ones or not.

Important in any case is the fact, that equation (26) contains three summands !

This has several consequences:

1. To which extent all the summands of equation (26) will have to be inserted into the FPSIF-theory, in order to assure a proper operation of the MMDR-converter or the EEDR-converter or some other ZPE-energy-converter cannot be predicated now. It will have to be a matter of further investigations. This will be one of the very first tasks for a theoretician, as soon as the resources will be available, to begin with the practical construction and manufacturing of a ZPE-motor. If the second or third summand in the rectangular bracket will deliver remarkable contributions to the $\vec{E}$-field-strength, this might have the consequence of a renewal of the MMDR-design or of the EEDR-design. It might occur, that these design alterations will become necessary, in order to find a proper design, which is able to function at all, or it might be possible, that a renewal might have the consequence of recommendable design alterations, in order to make the engine work better. A serious risk is not existing, that the summands no.2 and no.3 might prevent my design-development of the MMDR- and of the EEDR- converters (see sections 1-4) from working, because the summands no.2 and no.3 have factors of "c" and "c^2" in their denominators, different from the summand no.1.
2. An additional consideration of the second and/or third summand can also have the consequence, that completely new principles of construction or possibilities for design development will occur, leading to constructions which would not be available with the mere consideration of the very first summand alone (as they had been prescribed in the sections 1-4). Example: If we regard the very high velocity of the motion of some of the engine-components as disadvantageous, because these high velocities are difficult for realization, we can even think about the possibility to **renounce** the very first summand, and to develop an engine, which works only on the basis of the second and third summand, or perhaps only on the basis of one of those both summands. Interestingly, the third summand does not depend on the distance between the partners of interaction (!!) and not on their velocities. This opens totally new technical perspectives with regard to the realization of a practical engine. But it also opens totally new perspectives for a handling of the electromagnetic interaction, because it creates the possibility, to use this interaction without taking care of the distance between the interacting partners. This is a fact, which most of us do not have in mind, when we think about electromagnetic interaction – and it goes far beyond mere technical or physical aspects.

The consideration of all these consequences, requires already from the very beginning of the development (from the very first day, when I have the possibilities to come back to my scientific work), very detailed theoretical investigations.

Nevertheless it should be emphasized, that the very first summand, on which my FPSIF-principle is based, is the dominant summand in the rectangular bracket (which makes the application of the FPSIF-principle on this special summand most important for the construction of a ZPE-motor), because the second summand has a factor of c in its denominator, and the third summand even a factor of c^2, making these summands remarkably smaller than the very first one. In how far the second and third summand can play roles (or not, due to their small absolute values), will have to be clarified also with a theoretical analysis. On the one hand, this arises the question, whether the fields according to the second and the third summand, can be of real technical importance – different from the very first summand, which is for sure of technical importance. On the other hand, it contains a calming consequence, because it expresses, that the emitted (lost) field-energy due to the second and the third summand is not very large, so that it will not disturb the operation of ZPE-converters working according to the very first summand, such as my EMDR, MMDR and EEDR do.

An example for the basics of a construction of alternative ZPE-engines, following the third summand could be: We can bring two electrical charges into oscillation (which can perhaps even accelerate each other, following the EEDR-principle according to equation (20)), and utilize the energy (of the field) being emitted perpendicular to the direction of the oscillation, because in this direction of observation, the direction of the retarded unit-vector $\vec{e}_{r'}$ alters most strong, so that the third summand will be especially large, if we utilize it in this direction (see Fig.31). (This is known as the functioning-mechanism of the Hertz'ian dipole-emitter.) Side-idea: Perhaps this principle might also give us a means, to utilize energy emitted from a EEDR-converter with oscillating electrons (or electrically charged particles).

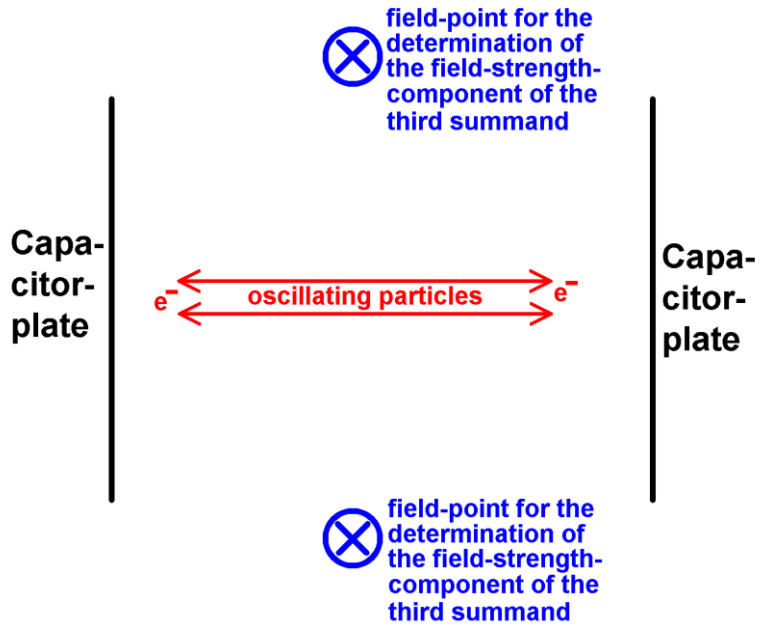


Fig. 31:

Example for the detection of a field according to the third summand of equation (26).

6. A Motionless-Converter according to the FPSIF-theory

6.1. Electrotechnical Basics

A very first basic idea, how to find approaches to motionless-ZPE-converters, can be found in literature, for example at Stefan Marinov [Mar 88-98], see also [Vol 85]. Central element of such a motionless-setup can be an electrical transformer, consisting of a yoke with at least minimal two coils, combined with the knowledge, that extremely short and high frequency pulses must be submitted into the coils (see Fig.32).

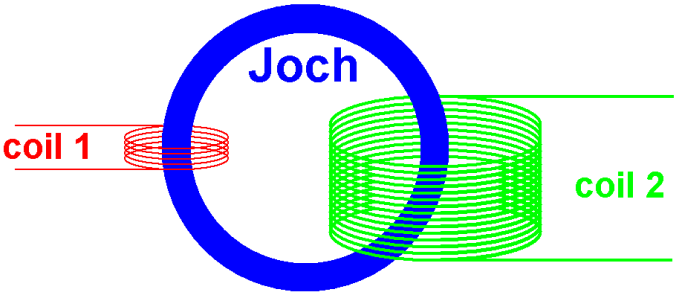


Fig.32
Principle and fundamental concept for the example of an imaginable zero-point-energy converter without any (material) parts in motion, operating on the basis of magnetic fields in motion, so that the magnetic fields have to pass a yoke with finite speed of propagation. The yoke and the coils reassemble strongly to an electrical transformer, but their dimensions have to be adjusted especially to the requirements of the FPSIF-principle.

If the FPSIF-theory really is capable to act as fundamental theoretical basis of ZPE-conversion, this theory must be capable to explain also such a motionless-converter, and it must allow the calculations for computer simulation, computation, construction and design-development of a motionless ZPE-converter-system. Thus, we immediately come to the crucial question: Where is the time delay, representing the finite speed of propagation of at least (minimum) one field of interaction (here in our case, this is the magnetic field), which enables the setup, to convert zero-point-energy according to the FPSIF-theory ?

The answer is as simple as the setup according to Fig.32: In the yoke.

Explanation: A short voltage-pulse, applied to the primary coil, causes an electric current in this coil, which produces a magnetic field. This magnetic field (and its magnetic flux) induced by the primary coil, passes the yoke, needing therefore a certain amount of time, and after this “yoke-delay”, the magnetic flux arrives at the secondary coil. As soon as it reaches the secondary coil, the flux induces a voltage there. In turn, the secondary voltage causes an electric current in the secondary coil, which acts back via a magnetic field and a magnetic flux, passing the yoke (with some certain delay in time), finally coming back to the primary coil, inducing a voltage there. But – and this is the crucial point – the effects from coil 1 onto coil 2 and then back again from coil 2 onto coil 1, have to respect the finite propagation speed (of the magnetic field and flux) inside the yoke, and this propagation speed should be in reality remarkably slower, than the vacuum speed of light. The propagation speed of the magnetic field in the yoke, will have to be measured when a prototype of a FPSIF-motionless converter shall be built.

As a preparation to construct and to build a motionless ZPE-converter according to the FPSIF-theory, it is necessary, to simulate such a system on the computer. Therefore, the behaviour of the electrical transformer and the yoke, has to be simulated on the one hand **without** taking the finite runtime of the magnetic field and its flux inside the yoke into account (as it usual in standard electrotechnical approaches), and on the other hand, **with** taking the finite runtime of the magnetic field and its flux inside the yoke into account (which is the FPSIF-approach). The development of such a computer-simulation is the central contents of section 6 of the preceding article.

For a real setup, it must be of course taken into account, that a coil being stimulated with a voltage-pulse, can only accept electrical current with finite rapidity (see Fig.33 and equation 27). This fact, as well as the material properties of the yoke, define an upper limit to the operating frequency of all motionless ZPE-transformer-converters containing coils and yokes.

$$I(t) = I_0 \cdot \left(1 - e^{-\frac{t}{\tau}}\right) \quad \text{and} \quad U_L(t) = U_0 \cdot e^{-\frac{t}{\tau}} \quad \text{with} \quad \tau = \frac{L}{R} \tag{27}$$

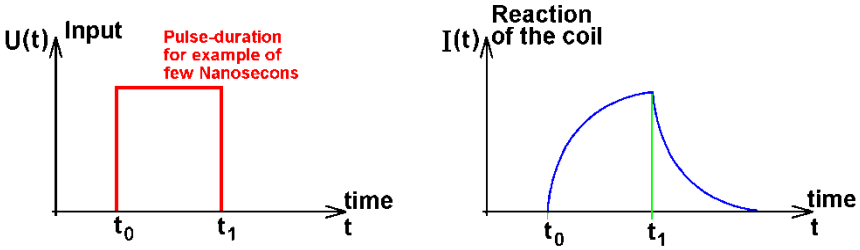


Fig.33
The reaction of a coil (namely of the current inside the coil) onto an input voltage-pulse, is well-known from standard literature of electrical engineering.

For the development of such a computer-simulation (of an electrical transformer) **with** and **without** taking the finite propagation speed of the magnetic fields (and the flux) into account, the motion of the charge carriers (these are the electrons in the wire) has to be taken into account in real dynamic consideration; this means that is necessary to put up the differential-equations of the system. Obviously, the Ohmic resistance of the coils (of their wires) and of the wires between the coils have to be taken into account therefore. Thus, the setup of Fig.34 contains Ohmic resistors additionally to the coils, with the intention that R_1 and R_2 represent not only the Ohmic resistance of the coils and the wires, but they shall also allow, to take additional (electrical) consumers into account.

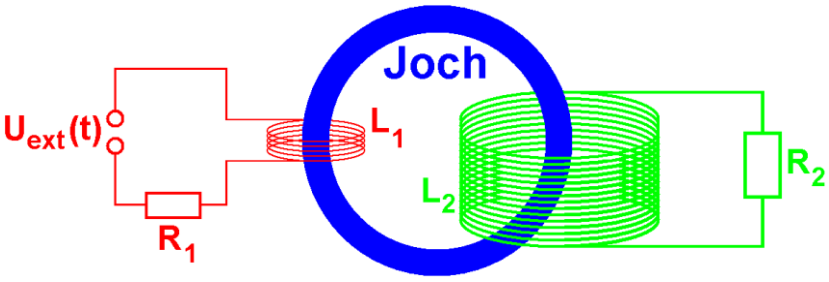


Fig.34
With this addendum to Fig.32, the setup begins to be a basis for a realistic computation of an electric transformer.

Same as an electromotor (or as for instance an EMDR-converter), can convert ZPE-energy when being dimensioned in appropriate manner (taking the finite propagation speed of the field into account !), an electrical transformer can convert ZPE-energy. Every electric device can be made to become a ZPE-energy-converter, as soon as we take the finite propagation speed of the magnetic fields into account and adapt the dimensions of the system.

The differential equations of the system (of Fig.34) can be derived as usual from Kirchhoff's rules, according to equation (28):

$$\begin{aligned} &\text{Mesh rule:} && Uext(t)+U_{R1}+U_{L1}=0 && (\text{in the primary circuit}) \\ &&& U_{R2}+U_{L2}=0 && (\text{in the secondary circuit}) \\ &\text{Chain rule:} && I_{R1}+I_{L1}=0 && (\text{in the primary circuit}) \\ &&& I_{R2}+I_{L2}=0 && (\text{in the secondary circuit}) \end{aligned} \qquad (28)$$

Because of the retraction of each of the both coils onto the other one (namely due to the yoke), we write the electrical voltages of the coils, which are in connection with the yoke, according to equation (29):

$$\begin{aligned} U_{L1} &= L_{11}\cdot\tfrac{d}{dt}I_1+L_{12}\cdot\tfrac{d}{dt}I_2 = L_{11}\cdot\dot{I}_1+L_{12}\cdot\dot{I}_2 \\ U_{L2} &= L_{21}\cdot\tfrac{d}{dt}I_1+L_{22}\cdot\tfrac{d}{dt}I_2 = L_{21}\cdot\dot{I}_1+L_{12}\cdot\dot{I}_2 \end{aligned} \qquad (29)$$

The formula symbols in equation (29) can be understood as:

$L_{11}=L_{1\leftarrow 1}=$ Inductivity of coil no.1 onto itself
$L_{12}=L_{1\leftarrow 2}=$ Inductivity of coil no.2 onto coil no.1
$L_{21}=L_{2\leftarrow 1}=$ Inductivity of coil no.1 onto coil no.2
$L_{22}=L_{2\leftarrow 2}=$ Inductivity of coil no.2 onto itself

Identical Indicés (L_{11} and L_{22}) stand for the reaction of each coil onto itself according to Lenz's rule, mixed Indicés (L_{21} and L_{12}) stand for the reaction of each coil onto the other coil. The correctness of this approach and this differential-equation-system is also confirmed by [Gau 13].

If we put equation (29) into equation (28), we finally come to the differential-equation-system of (30), describing our electrical transformer of Fig.34.

$$\begin{aligned} &\text{Mesh rule:} && Uext(t)+R_1\cdot I_1+L_{11}\cdot\dot{I}_1+L_{12}\cdot\dot{I}_2=0 && (\text{in the primary circuit}) \\ &&& R_2\cdot I_2+L_{21}\cdot\dot{I}_1+L_{12}\cdot\dot{I}_2=0 && (\text{in the secondary circuit}) \end{aligned} \qquad (30)$$

Thereby it is sufficient (due to the chain-rule) to use the electrical current as given just within each single circuit, as there is the primary-current $I_1=I_{R1}=I_{L1}$ and the secondary-current $I_1=I_{R2}=I_{L2}$, because the electrical current passing each Ohmic resistor, is identically the same as the electrical current passing the

coil which is connected directly to the namely resistor. If necessary, (positive or negative) algebraic signs are to be used according to the rules of electrical engineering.

Explanations are necessary for the determination of the inductances L_{11}, L_{22}, L_{21}, L_{12}. The self-inductances, which are to be understood as an inductances, with which each coil acts into itself, can be taken very easy from standard formula-books (such as for instance [Stö 07]), and the follow equation (31).

$$L_{ii} \approx f \cdot \frac{\mu A n_i^2}{l} \quad \text{for a short cylindrical coil, with a corrction-factor of } f \approx \frac{l}{l+r} \qquad (31)$$

and l = length of the coil ; r = radius of the coil ; A = cross-section area of the coil

n_i = number of windings ; $\mu = \mu_0 \cdot \mu_r$

The alternate inductances, with which each of the both coils acts onto the other one, can be derived as following: We calculate the magnetic field and the magnetic flux, by which each coil induces a voltage in itself (Lenz's rule) and a voltage in the other coil. According to standard formula-books, the magnetic field of the cylindrical coil is given by equation (32).

$$H = \frac{n \cdot I}{\sqrt{l^2 + r^2}} \quad \text{with } l = \text{length of the coil ; } r = \text{radius of the coil ; } n = \text{number of windings ; } I = \text{electrical current} \qquad (32)$$

Additional remark: a widespread approximation neglects r in a simplified approach.

And this field induces a voltage in every coil, which is exposed to this field, according to equation (33):

$$U_{ind} = -\frac{d}{dt}\psi \qquad \text{with } \psi = \int \vec{B} \cdot d\vec{A} \ . \qquad (33)$$

Due to the fact, the magnetic flux is concentrated inside the yoke, the cross-section areas of the coils, do not play an important role, with regard to the transportation of the magnetic flux from each coil to the other one. Thus the cross-sectional area "*A*" is to be understood as the cross-sectional area of the yoke's material. Consequently, equation (33) leads us to the induced voltage in the coil "j" according to equation (34):

$$U_{ind} = -n_j \cdot \dot{\vec{B}} \cdot \vec{A} \ , \quad \text{where } n_j = \text{number of windings of the coil, inside which the voltages induced} \qquad (34)$$

It we put the magnetic field of the coil "i" according to equation (32) into (34), we derive

$$U_{ind} = -n_j \cdot \frac{n_i \cdot \left(d/dt\, I_i\right) \cdot \mu_0}{\sqrt{l_i^2 + r_i^2}} \cdot A \ , = -n_j \cdot n_i \cdot \frac{\left(d/dt\, I_i\right) \cdot \mu_0}{\sqrt{l_i^2 + r_i^2}} \cdot A \ , \qquad (35)$$

where the index "i" always represents the dimensions of the field-generating coil, and the index "j" always represents the dimensions of the field-accepting coil, so that the field induces a voltage into the coil "j". The value of "A" remains without any index, because the cross-section area of the yoke is identically the same for both coils (although this condition could be altered due to the choice of the dimensions of the setup, later). Therefrom we can compute the properties of each coil and its effect on each other coil via the yoke.

If we put these findings into equation (30), we can derive the differential-equation for the primary circuit, which is written in (36):

$$U_{ext}(t) = L_{1\leftarrow 1} \cdot \dot{I}_1 + L_{1\leftarrow 2} \cdot \dot{I}_2 + R_1 \cdot I_1 \ = \ L_{11} \cdot \dot{I}_1 + L_{12} \cdot \dot{I}_2 + R_1 \cdot I_1 \qquad (36)$$

$$\text{with } L_{11} = L_{1\leftarrow 1} = \frac{-n_1^2 \cdot \mu_0 \cdot \mu_r}{\sqrt{l_1^2 + r_1^2}} \cdot A$$

$$\text{and } L_{12} = L_{1\leftarrow 2} = \frac{-n_2 \cdot n_1 \cdot \mu_0 \cdot \mu_r}{\sqrt{l_2^2 + r_2^2}} \cdot A$$

In the same manner, we can put our findings into (30) and derive the differential-equation for the secondary circuit as written in (37):

$$0 = L_{2\leftarrow 2}\cdot \dot{I}_2 + L_{2\leftarrow 1}\cdot \dot{I}_1 + R_2\cdot I_2 \;=\; L_{22}\cdot \dot{I}_2 + L_{21}\cdot \dot{I}_1 + R_2\cdot I_2 \qquad (37)$$

$$\text{with } L_{22} = L_{2\leftarrow 2} = \frac{-n_2^2\cdot \mu_0\cdot \mu_r}{\sqrt{l_2^2 + r_2^2}}\cdot A$$

$$\text{and } L_{21} = L_{2\leftarrow 1} = \frac{-n_1\cdot n_2\cdot \mu_0\cdot \mu_r}{\sqrt{l_1^2 + r_1^2}}\cdot A$$

Please keep in mind: The interactions between the both electrical circuits (back and forth) go back to the inductances with mixed indices, and of course, the differential-equations in the differential-equation-system reflect the same behaviour.

(i.) If we solve the differential-equation-system of (36) and (37) directly (i.e. without taking the time-delay of the signals passing the yoke into account), we calculate the classical electrical transformer, which of course follows the law of conservation of classical (electrical and magnetic) energy.

(ii.) But in the opposite way, if we solve the differential-equation-system of (36) and (37) taking the time-delay of the (magnetic flux-) signals passing the yoke into account, we activate the FPSIF-conception, and thereby the transformer gains the capability to convert ZPE-energy into classical energy. In the following sections we will verify this statement by concrete computations.

6.2. Mathematical solution of the Differential-Equation-System

Perhaps for point (i), an analytical solution might be imaginable, but at least for point (ii), there is no possibility to get any analytical solution, so that a numerical iteration is necessary by principle. Additionally, it is desirable to allow arbitrary disturbance functions $U_{ext}(t)$, and this makes it is sensible to develop our numerical iterative solver for both approaches to the differential-equation-system according to (i) and in the same way according to (ii). Furthermore, an identical solver for both approaches to the differential-equation-system has the advantage, that we can compare the results **with** and **without** the FPSIF-delay directly, so that the conversion of ZPE-energy can be traced directly by the comparison of (i) and (ii). In reality, we develop only one solver-algorithm, which allows to apply the FPSIF-delay-time to be put zero of (is required) differently from zero.

An overview over several different numerical solution methods, applicable for the differential-equations as well as for differential-equation-systems, can be found for instance at [Teu 03] (see S.1052-1061).

For the benefit of the stability of the solution-function, I decided to apply a one-step method according to Euler, as it is known within the range of polygonal line methods. The problem is, that higher order methods normally turn out to be less stable in the solution-function. I have made tests with Runge-Kutta, Adams-Bashforth and Adams-Moulton.

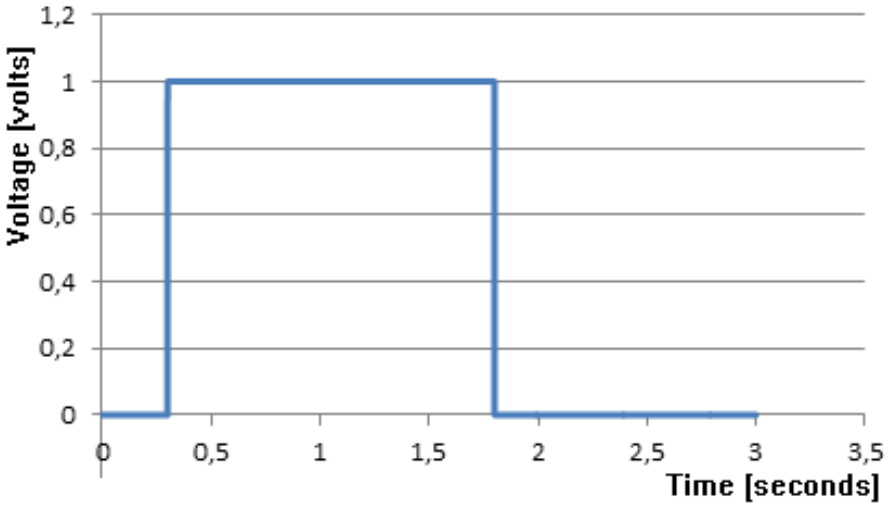
For the one-step method according to Euler, it is sufficient to dissolve the differential-equations (36) and (37) to the derivatives of the electric currents $\dot{I}_1$ and $\dot{I}_2$ as being written in (38).

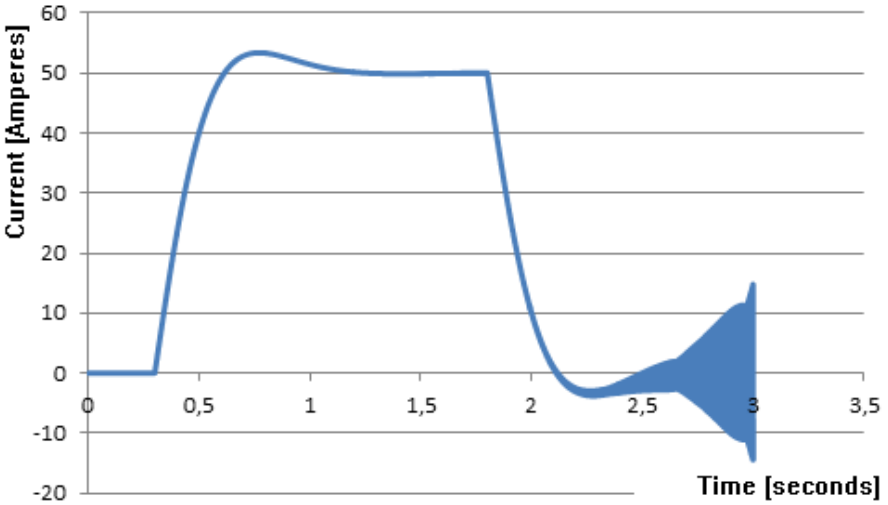
$$\frac{d}{dt} I_1 = \frac{1}{L_{11}}\cdot\left(U_{ext}(t) - R_1\cdot I_1 - L_{12}\cdot\left(\frac{d}{dt} I_2\right)\right) \qquad (38)$$

$$\frac{d}{dt} I_2 = \frac{1}{L_{22}}\cdot\left(0 - R_2\cdot I_2 + L_{21}\cdot\left(\frac{d}{dt} I_1\right)\right) \qquad (39)$$

Algebraic signs had to be adjusted (in the algorithm, see appendix 9.2) to the usual sign-conventions of electrical-engineering, in modification with respect to (36) and (37), in order to get sensible solutions.

Nevertheless, instabilities of the numerical iterative solutions, lead to remarkable problems, as known from literature and even from standard formula-books. The consequences are tremendous oscillations of the solution-function (see Fig.35 (a,b,c), File: „Ergebnis_001_dt=1E-7.xlsx“).





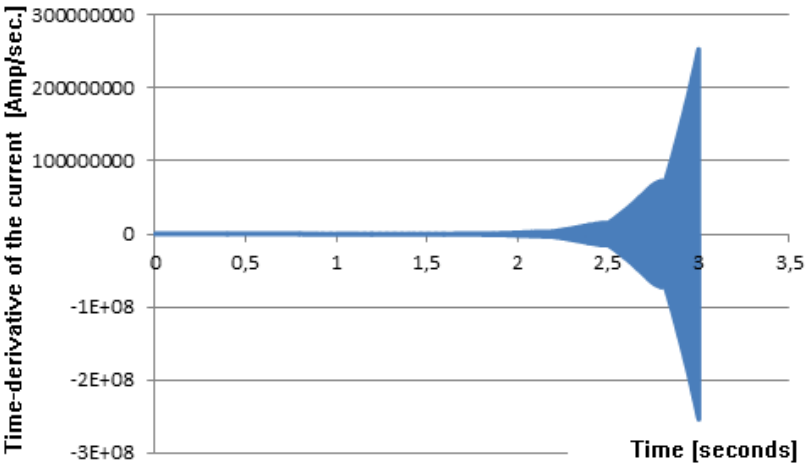


Fig.35
Example for the oscillation of the solution:

(a.) $U_{ext}(t)$ = excitation of the transformer by a voltage-input into the primary circuit (this is a disturbance function in the differential-equation).

(b.) $I_1(t)$ = electrical current in the primary circuit.

(c.) d/dt ($I_1(t)$) = time derivative of the electrical current in the primary circuit.

The solution-function oscillates that strong, that the solution-function cannot be recognised sensible.

In order to get rid of the problem of solutions, swinging up extremely much, a subroutine has been added to the computer-simulation-program (see appendix 9.2), which checks from time to time, whether the time-derivative of the primary current, exceeds a certain preselectable limit (see from line 248 on, in appendix 9.2: „Function aufschaukelt:Boolean“). If it is the case, that the oscillation exceeds a predefined limit, a smoothing procedure on the time-derive of the primary current and on the time-derivative of the secondary current is being performed, with the (desirable) consequence, that a further enhancement of

the oscillation of the solution-function is avoided, and furthermore that even the beginning of the (unwanted) oscillation is being suppressed. This is done by averaging the result, using an arithmetic mean value within the oscillation. For this purpose, the subroutine “Procedure Glaettung(Stelle:LongInt)“ has been developed (beginning at line 102 in the algorithm), which is being used, as soon as the oscillations of the solution-function exceed a predefined limit. Details regarding the operation of the programs and subroutines are explained in the below section 6.3.

In order to determine, whether the disturbing oscillations of the solution-function exceeds a certain limit or not, we need to define some type of measurable rate for the oscillation. A rather simple and reliable quantification therefore can be the following: We trace back the solution-function for a given number of points being already calculated (the number of points, which shall be used for this purpose, is provided by the parameter „Glättungsstrecke“). And for these points, we calculate the arithmetic mean value of the function-values, as well as the variance and the root mean square deviation of the variation of the single values around their mean value. As soon as the absolute value of the root mean square deviation, exceeds a certain percentage of the arithmetic mean value (the percentage is predefined by the parameter „SchaukelSensibilität“), we regard it necessary, to perform the smoothing procedure, which is done by calling the subroutine “Procedure Glaettung“.

The subroutine „Procedure Glaettung“ computes a regression-line along the last computed data of the solution-function, where the number of data points within “the last computed data” is predefined by the parameter “Glättungsstrecke”(+Delay, see below). For the regression, a linear regression-line is being regard as not sufficient, because the solution-function can have to follow remarkable curvatures, even within not too long distances. This behaviour of the solution-function makes a simple polygonal-line (as it can be obtained from several parts of a linear regression) inadequate. Thus, a regression parable of second degree was being tested and found to be good (see 40):

$$y(x) = a\,x^2 + bx + c \tag{40}$$

The determination of the three parameters of *a*, *b* and *c* is a simple task for beginners, as it can be for instance read at [Pap 97]. Under the keyword “regression-parable”, from page 710 on, the referred text-book describes the minimisation of the sum of the square-deviance (according to Gauss) between the $(x_i\,;\,y_i)$ - data-points and the parable (according to equation (40)), following the method of the Gauss’ian least square fit, as being described in equation (41):

$$\text{Sum of the square-deviance} \qquad S = \sum_{i=1}^{n}\left(y_i - \left(ax_i^2 + bx_i + c\right)\right)^2$$

$$\text{multiply} \Rightarrow S = \sum_{i=1}^{n} y_i^2 - 2\cdot y_i\cdot a\cdot x_i^2 - 2\cdot y_i\cdot b\cdot x_i - 2\cdot y_i\cdot c + a^2\cdot x_i^4 + 2\cdot a\cdot x_i^3\cdot b + 2\cdot a\cdot x_i^2\cdot c + b^2\cdot x_i^2 + 2\cdot b\cdot x_i\cdot c + c^2 \tag{41}$$

This sum has to undergo a minimisation with regard to three parameters of regression *a*, *b* and *c,* this means that a system of three extremum-problems (with three parameters) has to be solved as printed in equation (42):

$$\frac{\partial S(a,b,c)}{\partial a} = 0 \quad \text{and} \quad \frac{\partial S(a,b,c)}{\partial b} = 0 \quad \text{and} \quad \frac{\partial S(a,b,c)}{\partial c} = 0 \;, \tag{42}$$

If we put (41) into (42), we come to an equation-system of three equations with three unknown variables to be determined, as written in (43):

$$\frac{\partial S(a,b,c)}{\partial a} = a\cdot\left(\sum_{i=1}^{n} x_i^4\right) + b\cdot\left(\sum_{i=1}^{n} x_i^3\right) + c\cdot\left(\sum_{i=1}^{n} x_i^2\right) - \left(\sum_{i=1}^{n} x_i^2 y_i\right) = 0 \tag{43,a}$$

$$\frac{\partial S(a,b,c)}{\partial b} = a\cdot\left(\sum_{i=1}^{n} x_i^3\right) + b\cdot\left(\sum_{i=1}^{n} x_i^2\right) + c\cdot\left(\sum_{i=1}^{n} x_i\right) - \left(\sum_{i=1}^{n} x_i y_i\right) = 0 \tag{43,b}$$

$$\frac{\partial S(a,b,c)}{\partial c} = a\cdot\left(\sum_{i=1}^{n} x_i^2\right) + b\cdot\left(\sum_{i=1}^{n} x_i\right) + c\cdot n - \left(\sum_{i=1}^{n} y_i\right) = 0 \tag{43,c}$$

In reality, this is a linear-equation-system (in the parameters “a”, “b” and “c”), as can be seen immediately, as soon as we introduce the abbreviations according (44) into (43)

$$S_{X4} := \left(\sum_{i=1}^{n} x_i^4\right) \quad S_{X3} := \left(\sum_{i=1}^{n} x_i^3\right) \quad S_{X2} := \left(\sum_{i=1}^{n} x_i^2\right) \quad S_X := \left(\sum_{i=1}^{n} x_i\right)$$
$$S_Y := \left(\sum_{i=1}^{n} y_i\right) \quad S_{XY} := \left(\sum_{i=1}^{n} x_i y_i\right) \quad S_{X2Y} := \left(\sum_{i=1}^{n} x_i^2 y_i\right), \tag{44}$$

and use these abbreviations to bring (43) into the short form of (45):

$$\frac{\partial S(a,b,c)}{\partial a} = a \cdot S_{X4} + b \cdot S_{X3} + c \cdot S_{X2} - S_{X2Y} = 0 \tag{45,a}$$

$$\frac{\partial S(a,b,c)}{\partial b} = a \cdot S_{X3} + b \cdot S_{X2} + c \cdot S_X - S_{XY} = 0 \tag{45,b}$$

$$\frac{\partial S(a,b,c)}{\partial c} = a \cdot S_{X2} + b \cdot S_X + c \cdot n - S_Y = 0 \tag{45,c}$$

Analytical solution of the equation-system (45), developed by using a Computer-Algebra-System, helps us to find the three parameters as written in (46):

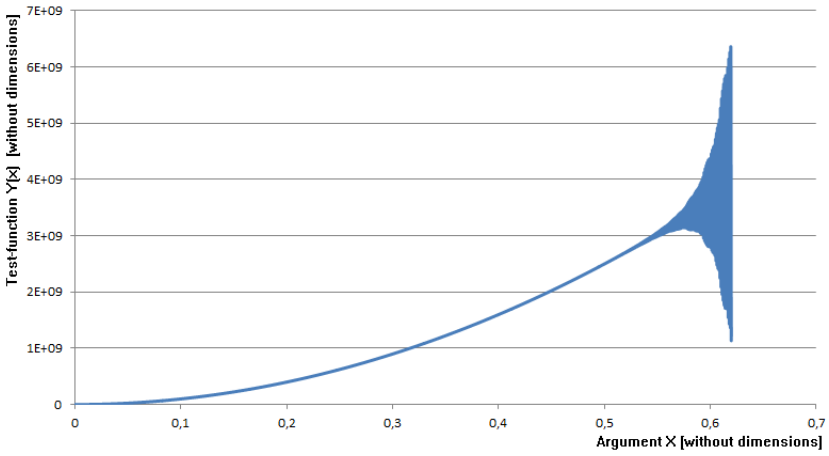
$$a = \frac{\left(-sx2y \cdot sx^2 + sx \cdot sx2 \cdot sxy + sx \cdot sx3 \cdot sy + n \cdot sx2y \cdot sx2 - n \cdot sxy \cdot sx3 - sy \cdot sx2^2\right)}{\left(-sx2^3 + 2 \cdot sx3 \cdot sx2 \cdot sx - sx4 \cdot sx^2 - sx3^2 \cdot n + n \cdot sx2 \cdot sx4\right)} \tag{46,a}$$

$$b = \frac{\left(sx2y \cdot sx \cdot sx2 - sx3 \cdot sx2y \cdot n + sx4 \cdot sxy \cdot n - sx2^2 \cdot sxy + sx3 \cdot sy \cdot sx2 - sy \cdot sx4 \cdot sx\right)}{\left(-sx2^3 + 2 \cdot sx3 \cdot sx2 \cdot sx - sx4 \cdot sx^2 - sx3^2 \cdot n + n \cdot sx2 \cdot sx4\right)} \tag{46,b}$$

$$c = \frac{\left(-sx2y \cdot sx2^2 + sx3 \cdot sx2y \cdot sx - sx4 \cdot sxy \cdot sx + sx2 \cdot sxy \cdot sx3 - sx3^2 \cdot sy + sy \cdot sx2 \cdot sx4\right)}{\left(-sx2^3 + 2 \cdot sx3 \cdot sx2 \cdot sx - sx4 \cdot sx^2 - sx3^2 \cdot n + n \cdot sx2 \cdot sx4\right)} \tag{46,c}$$

Now we have collected all necessary formula, to perform the smoothing-procedure. An exemplary application of this smoothing-procedure is illustrated in Fig.36. Part (a.) of this figure displays an arbitrary testing function, which suddenly begins to oscillate strongly, so strong that the solution does diverge. Part (b.) focuses our attention to the beginning oscillation with a zoom into the x-range of X = 0.55 … 0.62, within which the result of the smoothing-procedure, the regression-parable, is printed in red colour.

The allowance to apply such a smoothing procedure, is given as soon as the (red) regression-parable represents the course of the real function properly, i.e. as soon as the oscillation of the solution is only the consequence of the instability of the numerical iterative method for the solution of the differential-equation (or differential-equation-system). Because this condition is for sure fulfilled in our case (of the motionless ZPE-transformer), at least due to reasons of the laws of Physics behind our differential-equation-system, the regression-parable can be regarded as an appropriate tool to prevent the solution-function from diverging oscillations – namely as following: As soon as the oscillation begins to exceed a certain limit, we apply the smoothing procedure retrospectively, for a small distance of the solution function (this is the parameter „Glättungsstrecke“) and replace the oscillating solutions by the regression-parables. This smoothed regression-parables will now be good connection, to start the numerical-iterative solver-algorithm of the differential-equation from there on again. From this point on, where the numerical artefact of a diverging oscillation in the solution-function is being suppressed, the solver-algorithm delivers a quite good and stable solution-function for a quiet remarkable and useful distance further on. Of course, there will be some point (at some distance in the argument), when the solution-function will again begin to diverge, but it is no problem, to apply the smoothing-procedure at some distance again, as long as the distances between the applications of the smoothing-procedure are long enough. Due to the fact, that this method can be repeated several times (as often as necessary), the described technique is able to produce stable solutions of the differential-equations of our task.



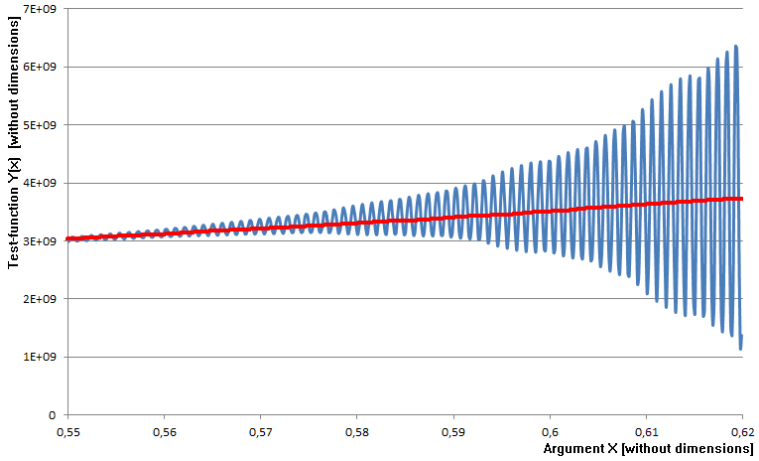


Fig.36

(a.) A test-function (here $y=const \bullet x^2$) is being superimposed by an oscillation, as it is typically produced by the differential-equation-solver following the polygonal-line method according to Euler (see equation (38) and (39)).
The goal is, to find a solver-algorithm on the basis of the polygonal-line method, which leads to a stable and useful solution.

(b.) In the moment, when the program begins to recognise the begin of the diverging oscillation of the polygonal-line method, the numerical artefact of the oscillation is replaced by a regression-parable (drawn in red colour), which will be used as starting condition for the further continued application of the polygonal-line method.

For the technique as described leads to sufficient stable solutions (of our differential-equation-system (38) & (39)), which appear correct, we can now use it to investigate, in how far the setup behind the differential-equation-system 8according to Fig.34), is capable to convert ZPE-energy. The conception is the following:

- If the time-derivative of the primary-current $\dot{I}_1$ acts immediately without any delay into the secondary-circuit, and if the time-derivative of the secondary-current $\dot{I}_2$ acts in the same manner immediately without any delay into the primary-circuit, our differential-equations must describe a classical electrical transformer, following the conservation of classical (electrical and magnetical) energy. This means that the (electrical) power being inserted into the system via U_{ext}, must compensate exactly that power being extracted by Ohmic losses, if we follow an integral average mean value over a full period of the signal. (The Ohmic resistors hereby represent a subsumation of all losses in the coils, wires, consumers, and so on . . .)
- But on the other hand, if the time-derivative of the electrical current of each coil, acts into the other coil (and thereby into the other differential-equation within the system) with a certain delay in time, caused by the yoke (in our algorithm, this delay is described by the parameter “Delay“), namely in connection with the FPSIF-conception, our differential-equation solver-algorithm has to apply the influence of $\dot{I}_1$ and $\dot{I}_2$ with a given retardation in time, namely when taking $\dot{I}_1$ into account within the secondary-circuit, and when taking $\dot{I}_2$ into account within the primary-circuit. And now it has to be investigated, whether the difference between taking the time-delay into account or not, has a remarkable effect onto the energy-balance and on the power-balance of the electrical transformer. In this case, the energy conservation has to be applied for the sum of classical electrical and magnetical energy plus the ZPE-energy of the quantum-vacuum.

By the way: Averaging the power over full periods of operation (in time) is the appropriate means to compute the energy-balance.

For the purpose of such an energy-balance-computation and power-balance-computation, we have to record the energy-fluxes according to equation (47):

$$E_{ext} = \int U_{ext}(t) \cdot I_1(t)\, dt \quad \text{external energy-supply via the } U_{ext}(t) \tag{47a}$$

$$E_{R1} = \int R_1 \cdot I_1^2(t)\, dt \quad \text{Ohmic (and other losses) on the primary side} \tag{47b}$$

$$E_{R2} = \int R_2 \cdot I_2^2(t)\, dt \quad \text{Ohmic (and other losses) on the secondary side} \tag{47c}$$

With the (yoke-) time delay being switched off (Delay=0), the transmission of the magnetic-flux has to follow the conservation of classical energy, according to equation (48), according to which the energy being brought from the external source U_{ext} into the primary circuit, must be absorbed exactly within the Ohmic losses of the primary circuit and within Ohmic losses of the secondary circuit. This means, that we supply energy into the primary circuit, and as far as this energy is not lost within the primary circuit, it must be consumed completely and exactly within the secondary circuit. (Remark: Algebraic signs have been adapted to the necessities of the sign-conventions of electrical engineering.)

$$E_{ext} - E_{R1} + E_{R2} = 0 \tag{48}$$

- In the case of a classical operation of the transformer (this is without delay), any deviation of the energy-balance from ZERO (i.e. $\Delta E = E_{ext} - E_{R1} + E_{R2} \neq 0$) has to be interpreted as uncertainty (unexactness) of the computation, due to the numerical iterative method of solution.
- In the opposite way, the computation with (yoke-) delay should lead to a deviation of the energy-balance from ZERO, and this deviation has to be interpreted as the sum of the uncertainty of the computation plus the energy being converted from the ZPE-energy (of the quantum-vacuum), which is E_{FPGW}, so that we have to determine in how far is $\Delta E + E_{FPGW} = E_{ext} - E_{R1} + E_{R2} \neq 0$.

The calculation of some energy E_{FPGW} being converted from the quantum-vacuum, can thus be only sufficient, if it is remarkably and significantly larger, than the uncertainty of the computation ΔE. This criterion can be reached and checked, by refining the steps of iteration of the solver-algorithm further and further.

We now want to test, whether a time-delay of the magnetic field inside the yoke, can be capable at all to enable our system, for the conversion of ZPE-energy. For this test, we follow an energy-balance-computation along a test-run (here „Dgl_Loeser_004c.dpr“) of the differential-equation solver-algorithm, and we perform this for several values of the delay, checking the energy-balance as a function of the delay-time. Therefore we drive our algorithm with the following input-parameters:

$$U_{ext} = \begin{cases} 0\,Volt \;\; for \;\; 0 \le t \le 0.04\text{sec.} \\ 1\,Volt \;\; for \;\; 0.04\text{sec.} < t < 0.24\text{sec.} \\ 0\,Volt \;\; for \;\; 0.04\text{sec.} \le t \end{cases} \tag{49}$$

```
n1:=200; n2:=200;                 {number of windings of the coils, primary (1) and secondary (2)}
Laen1:=1E-3; Rad1:=1E-2;          {length and radius of the coil number 1 (primary) in meters}
Laen2:=1E-3; Rad2:=1E-2;          {length and radius of the coil number 2 (secondary) in meters}
DD1:=5.0E-3; DD2:=5.0E-3;         {thickness of the wire: diameter of the wire of the coils in meters}
A:=Sqr(4E-3);                     {cross-section area of the yoke in square-metres = m²}
mur:=1.00;                        {magnetic material-constant of the yoke, without physical unities}
Delay:= . . . ;      {variable -> see Tables 4 & 5; delay due to the yoke, number timesteps "dt"}
R1:=0.02; R2:=0.02;               {Ohmic resistors, physical unities: Ohm}
tanf:=0; dt:=1E-7; tend:=0.4; {time, time-steps and time-end in seconds}
SchaukelSensibilitaet:=0.05; {value with regard to the oscillation of the numerical-iterative solver}
Glaettungsstrecke:=50;    {value with regard to the retrospective smoothing, see above}
```

Table 4 gives an overview over several results, which have been achieved for different values of the delay – and all of them **without** switching on the smoothing-procedure for the stabilisation of the solution, i.e. without the means of regression-parables. Anyhow, we already find the option for the conversion of zero-point-energy (from the quantum-vacuum), because the yoke's signal-delay significantly influences

the energy-balance (of the system), and this influence is growing more and more, the larger the (yoke-)delay is being inserted. The function $\Delta E + E_{FPGW}$ is a strictly monotonously growing function of the delay "dt", which is to be interpreted as a clear criterion for the fact, that the energy-gain from the quantum-vacuum continuously follows the delay (of the magnetic signal in the yoke). Of course different runs of the algorithm, with different step-widths, lead to strong fluctuations of the results, but it is not surprising, because the stabiliser of the numerical iteration is not yet switched on.

Delay (Flux-retardation in the yoke)	$\Delta E + E_{FPGW}$ = computation-uncertainty plus conversion of ZPE-energy	Computation-fineness (size of the time-steps)
0	$\Delta E =$ -2.896·10^{-5} Joules	dt = 1·10^{-7} sec.
2·dt = 2·10^{-7} sec.	-2.6473·10^{-5} Joules	dt = 1·10^{-7} sec.
5·dt = 5·10^{-7} sec.	-1.8991·10^{-5} Joules	dt = 1·10^{-7} sec.
10·dt = 10·10^{-7} sec.	-0.6521·10^{-5} Joules	dt = 1·10^{-7} sec.
20·dt = 20·10^{-7} sec.	+1.8418 ·10^{-5} Joules	dt = 1·10^{-7} sec.
50·dt = 50·10^{-7} sec.	+9.323 ·10^{-5} Joules	dt = 1·10^{-7} sec.
A refinement of the time steps "dt" is following, in order to improve the quality of the numerical iteration.		
50·dt = 5·10^{-7} sec.	-2.1237·10^{-5} Joules	dt = 1·10^{-8} sec.
100·dt = 10·10^{-7} sec.	+0.8768 ·10^{-5} Joules	dt = 1·10^{-8} sec.

Tab.4: Different values of the time-delay of the magnetic flux within the yoke are being printed here, and they indeed have an influence onto the energy-balance, even if the smoothing-stabiliser of the solution is not yet switched on.

The next table 5 displays several results for the energy-balance (for varying delay), but now, and this is the important difference to table 5, with the smoothing-stabiliser of the solution being switched on, so that the solutions are stabilised by regression-parables if necessary. The results confirm the conversion of zero-point-energy absolutely clearly, because the FPSIF-effect, for which we are searching, now surmounts the computation-uncertainty very clearly (especially in the comparison of ΔE at dt=0). The result surmounts the numerical noise by orders of magnitude. Questionable is the alteration of the algebraic sign of the result, with enhanced number of points for the smoothing-procedure (Glättungs-strecke „GS"). This indicates, that the time-steps for the numeric iteration must be refined tremendously in order to get reliable results. This problem is solved, and its solution is described in the further course of the paper (see below).

Delay (Flux-retardation in the yoke)	$\Delta E + E_{FPGW}$ = computation-uncertainty plus conversion of ZPE-energy	Computation-fineness (size of the time-steps)
0	+5.811508·10^{-6} Joules (at GS=20)	dt = 1·10^{-7} sec.
2·dt = 2·10^{-7} sec.	+9.209519·10^{-6} Joules (at GS=20)	dt = 1·10^{-7} sec.
5·dt = 5·10^{-7} sec.	+45.09396·10^{-6} Joules (at GS=20)	dt = 1·10^{-7} sec.
10·dt = 10·10^{-7} sec.	-359.21·10^{-6} Joules (at GS=50)	dt = 1·10^{-7} sec.

Tab.5: Different values of the time-delay of the magnetic flux within the yoke are being printed here, and they indeed have an influence onto the energy-balance, which is now absolutely clear and significant, because the smoothing-stabiliser of the solution is switched on.

There is still a strong necessity for a drastic enhancement of the fineness of the time-steps "dt", and thus an enhancement of the resolution of the computation is still to be done. But this has the consequence of a tremendous increase of the CPU-time (per each run of the algorithm). The only possible remedy against this CPU-time-problem is a reduction of the length of the total time interval for the complete consideration. Fortunately this is not a difficult problem, because the durance of the time interval for the consideration was chosen very long up to now – much longer than necessary for a proper analysis of the operation of the transformer, as for instance the data-set of (49) represents a consideration-time-interval of nearly a quarter of a second, containing one single rectangular pulse. But the frequency as

given there, being 1/0.24 sec. = 4.17 Hz is absolutely no limit for a transformer, from the point of view of electrical engineering, so that the frequency can be enhanced remarkably, as soon as we reduce the durance of the rectangular pulse considerably. If we for instance chose a frequency of 333.3 Hz for the rectangular pulse, a time resolution of dt = $2 \cdot 10^{-12}$ seconds is quite convenient to realise (leading to the CPU-time of few hours), to compute a smoothing-stabilised solution of the differential-equation. From this consideration, we come to a set of input-parameters, as following („Dgl_Loeser_004e(2nshochfein)“):

$$U_{ext} = \begin{cases} 0\,Volt \;\; for \;\; 0 \le t \le 0.3\text{millisec.} \\ 1\,Volt \;\; for \;\; 0.3\text{millisec.} < t < 1.2\text{millisec.} \\ 0\,Volt \;\; for \;\; 1.2\text{millisec.} \le 3.0\text{millisec.} \end{cases} \qquad (50)$$

```
n1:=100; n2:=100;                 {number of windings of the coils, primary (1) and secondary (2)}
Laen1:=10E-3; Rad1:=2E-2;         {length and radius of the coil number 1 (primary) in meters}
Laen2:=10E-3; Rad2:=2E-2;         {length and radius of the coil number 2 (secondary) in meters}
DD1:=1.0E-3; DD2:=1.0E-3;         {thickness of the wire: diameter of the wire of the coils in meters}
A:=Sqr(4E-3);                     {cross-section area of the yoke in square-metres = m²}
mur:=1.00;                        {magnetic material-constant of the yoke, without physical unities}
Delay:=1000;                      {delay in yoke, number timesteps "dt"}
R1:=0.08; R2:=0.08;               {Ohmic resistors, physical unities: Ohm}
tanf:=0; dt:=2E-12; tend:=3E-3;   {time, time-steps and time-end in seconds}
SchaukelSensibilitaet:=0.05;      {value with regard to the oscillation of the numerical-iterative solver}
Glaettungsstrecke:=200;           {value with regard to the retrospective smoothing, see above}
```

The result now becomes absolutely clear, because the energy-gain (from the quantum-vacuum) is by several orders of magnitude larger than the computation uncertainty: (51)

Time-resolution of the computation: dt = $2 \cdot 10^{-12}$ sec.

⇨ Without Delay => ΔE = $-3.61060 \cdot 10^{-12}$ Joules (without Delay it must be $E_{FPGW} = 0$ by principle)

⇨ With Delay of 1000 timesteps = 2 nanoseconds => $\Delta E + E_{FPGW} \approx \Delta E$ = $+2.797445 \cdot 10^{-7}$ Joules

Not in every computation (which I performed later, using this algorithm), the conversion of ZPE-energy was confirmed so clear and significant. For instance in section 6.4, comparable test-computations with a yoke having a material constant of $\mu_r = 12$ have been performed; and then the significance of the results (being understood as the difference between ΔE und E_{FPGW}) is less clear than at (51). This indicates, the algorithm still requires further tests, and probably a further enhancement of the fineness of the time-steps, with the side-effect, that a further enhancement of the CPU-time (which is now already several hours per each run) will be inevitable.

However: The mentioned restrictions do not disturb the findings, that the differential-equation-system as presented here, has a clear mathematical solution, and that this solution depends significantly on the time-delay within the coupling (representing the yoke), between the both differential-equations of the system. The consequence for physics is a violation of the conservation of classical types of energy (here electrical and magnetical energy-summands), stating that an other type of energy must be included into the law of energy conservation; and from former work we know, that this additional type of energy must be identified as zero-point-energy of the quantum-vacuum.

In combination with the knowledge, that our differential-equation-system is normally used, to describe and to simulate (on the computer) an electrical transformer, it is immediately clear, that an electrical transformer can be modified into a motionless ZPE-energy-converter, as soon as the time-delay of the magnetic flux, passing the yoke, is taken into account. But certainly it is also clear, that within a real existing engine, the conversion of ZPE-energy is only possible, if the transformer is designed in an appropriate way (which is very much (extremely) different from classical transformers). One aspect for the design-development of a ZPE-motionless-transformer, is a maximisation of the working-frequency,

namely of the number of electrical or/and magnetical pulses per time. Another aspect is the extreme minimisation of power-losses (as for instance Ohmic losses). In our computation-example of equation (N26), the power which can be extracted maximally from ZPE-energy, just even reaches the microwatt-range, as being estimated in equation (52) – and a useful application of the setup is only possible, if the energy and power being converted from ZPE-energy, is not lost mainly within the system itself (and of course, stray-fields and other losses have not yet been taken into account, within our considerations).

$$P = \frac{\Delta E + E_{FPWG}}{\Delta t} = E_{FPWG} \cdot \nu \approx +2.797445 \cdot 10^{-7}\ \text{Joule} \bullet 333.3\,Hz \approx 93.2\,\mu W \qquad (52)$$

Perspectives to future work:

At first, the practical development of a design, of a motionless ZPE-energy transformer, now requires practical measurements in the laboratory: Up to now, I do not have any measurements, giving dependable values of the time-delay, of the finite propagation speed of the magnetic fields and flux, passing the yoke. The question of the time-delay for a real existing yoke material is still open.

It will be recommendable to measure several materials (as many as possible) and compare their behaviour with regard to the time-delay, in order to find a material which allows maximum delay, corresponding to a minimum propagation speed of the magnetic field inside the yoke-material. If we have in mind, how different materials allow different propagation speeds for electromagnetic waves, it should not be surprising to expect remarkably differences for the propagation speed of magnetic fields, between different materials.

Classical electrical engineers are used to compute electrical transformers with the approximation of infinitely fast propagating magnetic fields within the yoke, and this approximation (which is normaly rather good) is blocking their view onto the conversion of zero-point-energy.

If we want to get rid of this brain-blocking approximation, we have to take into account the finite propagation speed of the magnetic fields in the yoke, as being described by the FPSIF-theory. Therefore we have to measure the propagation speed first, before we can insert sensible values (which are to be derived from measurements) into the existing theory and into the existing simulation-software (as being presented in the present publication). Such measurements are now the next recommendable step of work. As soon as these measurements can be done, we can use the measuring-results, in order to come to the concrete practical design-development of a FPSIF-transformer for the motionless conversion of zero point-energy-from the quantum-vacuum.

6.3. Explanations regarding the Algorithm for Compersimulation

This section 6.3 has the purpose, to illustrate as good as possible, the method for the numerical iterative solution of the differential-equation-system, for the computer-simulation of a transformer, taking the finite propagation speed of the magnetic fields inside the yoke into account. This means, that 6.3 is mainly a section, describing mathematical approaches and programming techniques. The source-code of the software, by which the algorithm for our purpose has been developed, is printed in appendix 9.2, where everybody can read the practical realisation of the solution-method explicitly. On the following pages, I want to explain the working principles of the algorithm.

The original source-code of the algorithm (in Delphi Pascal), as being printed in appendix 9.2, is supplemented (for the publication) by line numbers in red colour at the left side of each line, which are not part of the original program, but which have the purpose to make it most easy, to refer to special lines of the program. Now we first want to discuss a general overview over the whole program, and after this discussion is done, we want to turn our attention to numerous details within most of the components of the program.

The lines number 1-7 contain the header of the program, and the lines number 8-41 contain the declaration of the variables. For we will speak about the variables and their meaning, in connection with the phase of initialisation (of all variables) at the beginning of the main body of the program, it is not necessary to discuss the variables already now during their declaration.

The lines number 42-48 stand for a little utility, which has only the simple purpose to wait, until the user presses a button, and this only has the helpful sense, to make the practical development of the software convenient.

A further practical utility is written in the lines 49-101, which has the purpose to perform the output of the results (or of any arbitrary data), into a data-file which can be read with Excel. The export of arbitrary data into Excel has (mainly) the purpose to allow convenient post-processing of the data, as it can be for instance helpful for graphical display. Up to this position (line number 101), that program contains only general useful components (and routines), which do not require any further detailed explanation.

Just an enumeration of the contents of the different columns for Excel-data-export, as being used in the further course of the program, might be interesting here:

A: counter, displaying a running number
B: time „t“
C: $U_{ext}(t)$
D, E: electrical current in the primary circuit $I_1(t)$, and its derivative to time dI_1/dt
F, G: electrical current in the secondary circuit $I_2(t)$ and its derivative to time dI_2/dt
H: power-input from $U_{ext}(t)$
I: power-output via RV_2 , a consumer-resistor in the secondary circuit
J: power-output via RV_1 , a consumer-resistor in the primary circuit
K: uncertainty of the computation plus conversion of zero-point-energy (see above and below)
L,M: electrical charge Q_1 and voltage U_1 (in the primary capacitor)
N,O: electrical charge Q_2 and voltage U_2 (in the secondary capacitor)

From line 101 on, we find the smoothing-procedure (called „Procedure Glaettung“), which goes up to line 247, and thus is a dominant part of the volume of the program (although many of its lines are only comment-lines, which represent former write commands, which had been used temporarily during the phase of the program-development, for the purpose of data-control, during the computation of the smoothing-process). We will soon speak about further details of the smoothing-procedure for the stabilisation of the solution function in detail. This discussion will follow after the overview-discussion in which we are here. The data-control-print lines being commented out, have not been deleted only because of the purpose, to make it easier for the reader, to comprehend and reconstruct the program (and to insert alterations, if required).

The Boole'ian „Function aufschaukelt“ (to be found from line 248 up to line 270) has the purpose to find out, whether the solution-function already begins to oscillate by a disturbing amount or not. We check this most efficiently, with regard to the time-derivative of the primary-current, because the time-derivatives of the electrical currents, begin to oscillate much earlier than the currents themselves, because the integration-procedure from the time-derivatives, up to the currents themselves, have smoothing character, as always integration-procedures do. And this smoothing-character (of the integration) prevents the current-functions themselves, from oscillating remarkably, as long as the time-derivatives do not oscillate too much.

The „Function Uext(t)“ (lines 271-284) can be understood in the sense of a signal-generator, because it provides the voltage (and with it some energy) for any external excitation of the system, which is necessary for the operation of the transformer at all. Without the external excitation, the transformer would not have anything to transform, and so it could not work by principle. In the sense of the differential-equations, the external voltage Uext(t) is the disturbance-function, which makes the differential-equation-system inhomogeneous.

From line 285 on (up to line 301), we see the main program, which begins with the initialisation of the input-parameters (from line 287 on). All parameters, which are necessary for the algorithm (and for the whole program) are defined during the phase of initialisation, and there is no interactive data-input at all. All starting values for all parameters and for all variables are written directly within the source-code, namely during the phase of initialisation. This has two advantages, namely on the one hand, that the development of the program is rather efficient (because there is no necessity to enter any values of any parameters or variables, during testing-runs of the program), and on the other hand, the values of the input-parameters and variables are recorded very easy, namely directly when the source-code is stored on the magnetic hard-disc. Of course there would also be other possibilities to realise these purposes, but for the sake of efficiency, this method is very convenient.

The program requires not only so called “real” input-parameters, as being described up to now, but also some further variables, which have to be calculated directly from the “real” input-parameters – and they are calculated in the following lines (number 302-326). The mentioned programming-lines additionally contain a little consistency-check, which is now looking that the Ohmic resistances of the coils (namely of their copper-wires), are not larger than the total sums of all Ohmic losses and consumers (on the primary side as well as on the secondary side). If this condition would not be fulfilled, a practical realisation would not be possible by principle. Among the computed parameters and variables, we also find the inductances, with which the coils give loads to their own circuit, as well as to the other circuit.

In the lines 327-336 we find the preparation for the run of the differential-equation-solver, namely the initialisation of the remaining variables necessary for the control of the working-mode of the solver. They are not input-parameters of physics (describing the dimensions of the system), but they are necessary for the control of the mathematical operation of the solver (and thus they must be given as an input to the program).

Although the program-part from line 337-347 has the headline “Now we begin to solve the differential-equation-system”, it is not yet the central core of the inner loop, computing the solution-function. In reality, the program-part from line 337-347 has the purpose to compute the numerical start-specifications, which are necessary for the central core of the inner loop of the solver. The computation of the start-specifications are being regarded as the begin of the task, to solve the differential equations.

The actual core of the inner loop of the solver begins at line 348 and goes up to line 409. But these lines do not contain only the mere solution of the differential-equations, but they have to fulfil also some other necessities, as for instance the periodic call of the subroutine, which checks, whether an oscillation of the time-derivative of the solution-function already begins (making smoothing necessary) , or as for instance also a periodic storage of the prominent results, for the purpose of later export into an Excel-file; further necessities during these lines, when the central solver is running, are also tasks like the computation of the energy-balance, and so on… Although it reduces the clearness of the arrangement, the central core of the solver-loop had to be filled up with all these tasks, because the huge volume of the data of the xy-pairs of the solution-function, is far too large for a complete storage of all values, because of the extreme fineness of the discretisation in time-steps, i.e. the extremely small “dt”-steps which are necessary in direction of the abscissa, in order to get a sensible solution-function. Thus we do not have any other choice, but we must perform all intermediate computations and all auxiliary calculations, which are necessary for the evaluation of the results, directly within the central core of the solver-loop, because this is the only moment, when the complete results of the solution-function are available in the program. The storage of the results, for the purpose of graphical display later, can only be done with a reasonable amount of data, allowing good graphical solution of the plots, which we want to regard optically later (after the central solver-loop is finished).

The end of the program begins with line 410, and it goes until to the end of the source-code in line 429. In the first part of this section, namely from line 410 up to line 418, very few prominent and most relevant results, which are especially meaningful, are displayed on screen, so that the user can read them without the (time-consuming) necessity, to leave the program and to go into Excel. These data are mainly values of the energy-balance, which are most important for us, because they allow an estimation about the conversion of ZPE-energy. In the very last part of the program, from line 419 up to 429, there is only the export of the volume-reduced results (of the solution-function and of some other interesting

functions) into an Excel-file, for the purpose of graphical display (and for other types of data-evaluation) later externally. This export to an Excel-file is done optional, if required.

This is, what I want to say with regard to the overview over the program. We now want to begin with several explanations in detail, regarding many single parts and aspects of the program:

Smoothing:

The very first part of the program, which has to be discussed in detail, is the smoothing-procedure, named ”Procedure Glaettung“, which is developed to avoid and suppress numerical noise, so that the solution-function will be stabilised. This is a task of mathematics, not of physics, but it is a very important, essential and central part, because without it, the solution would not be usable for any evaluation of the results.

We begin the discussion of this smoothing-procedure with line number 102, where we see the typical heading of a Pascal-subroutine. For we know the solution-function only in discrete (numerical) steps, it is stored within data-arrays, namely in the form of xy-pairs of values. The values of the sums according to equation (44) are stored under the names as being used in (44), same as the coefficients of the second-order regression-polynomials according to equation (46).

The lines 109-115 are commented out: they only had had the purpose before, to allow the screen-control of the data of the electrical currents and their derivatives to time ($I_1, \dot{I}_1, I_2, \dot{I}_2$), but due to the huge data-volume, only some of the xy-data-pairs (which are computed as the youngest in time) can be brought to the display, namely those which are still in the data-storage, being made available for the smoothing-procedure (if necessary). Due to the tremendously large volume of date, it is impossible to keep more than these data-pairs in the temporary data-storage (RAM-memory). The number of xy-data-pairs being stored in such manner, is restricted to the number of times-steps “dt” necessary to realise the delay (for the runtime of the magnetic field in the yoke), plus an additional number of xy-data-pairs, which is given by the parameter named “Glaettungsstrecke“ (see input-parameters), representing the length of time-distance, being used to the smoothing-procedure. It is recommendable, not to make the time-distance for the application of the smoothing-procedure (the “Glaettungsstrecke“) too small; in any case, this time-distance must be somehow longer (better remarkably longer) than the time-distance of the delay. If the time-distance of “Glaettungsstrecke” would be too small, we would face the risk that the smoothing procedure would lose its capability, to smooth the solution-curves at all, so that the solution-function could not be made free from its disturbing periodic (numerical, artificial) noise. On the other hand, if the time-distance of “Glaettungsstrecke” would be too large, we would face the risk, that the solution-curves will become too languorous, losing their ability to follow the reality of physical behaviour of the system fast enough. The last mentioned problem will be especially in these cases difficult, in which the solution-function has a curvature, fitting not really good to a second order regression-parable. As long as the time interval (of smoothing) will not become too long, a the second order regression-parable always fits somehow acceptable to almost every solution-function, which can be expected to occur in our practical problems of physics (in our special task). (Of course we only have solution-functions in mind here, which are imaginable as realistic solutions to our electrical-transformer problem.) But as soon as the solution-function contains parts which alter their values very fast in time, the time-intervals for the smoothing-procedure have to be chosen correspondingly short, in order to allow, that the second order regression-parable that, can adapt itself fast enough to the real solution. In order to get sure about the reliability of the solution-function, the program can be run with different values for the time-interval „dt“ and for the smoothing-time-distance “Glaettungsstrecke”. By comparing the results of such different runs of the program, it is possible to determine, whether the algorithm is already converged sufficiently, or not.

We want to finish our considerations about the smoothing-time-distance, regarding the lines number 116-117, where the parameter “n” gets its value assignment, which is the number of the xy-data-pairs being used for the smoothing-procedure. During the working-phase of program-development, the parameter “n” could be printed onto the screen, using the command of line number 118, which is now commented out in the source-code of appendix 9.2.

The smoothing-subroutine shall only be applied to the first time-derivatives of the electrical currents ($\dot{I}_1$ and $\dot{I}_2$), not to the currents themselves, because the electrical currents (I_1 and I_2) begin to oscillate much later and much less, than their time-derivatives. By this means it shall be avoided, that the smoothing-procedure has direct access to the solution-function (i.e. to the result). The indirect access of the smoothing-procedure onto the solution, active only via its time-derivatives, is absolutely sufficient, for the stabilisation of the solver-algorithm (because integration does smoothing in any case). Hence, we have the assignment of the xy-data-pairs to the data-array for the smoothing-procedure in the lines 119-124, and they refer to the time-derivatives $\dot{I}_1$.

The computation of the sums, necessary for the determination of the regression-parable according to equation (50), is following in the lines 125-135. The lines 136-137 (being commented out) allow the screen-display of the values of these sums.

Now we have the sums for the computation of the parable-coefficients a, b, c, so that we can calculate these coefficients according to the equations (46 a,b,c). This task is done in the lines 138-144. An option for the screen-display of these coefficients is written in the lines 145-148, being commented out. Also being commented out (in the lines 149-151), is the option for the comparison of the xy-data-pairs with the regression-parable. Because a graphical display is often easier to see, then columns of numerical figures, the xy-data-pairs and the data of the regression-parable are also exported to an Excel-file, and this is done in lines number 152-166, so that a separate external graphical display of the comparison is possible in Excel rather convenient.

We continue our considerations with the lines 167-170, in which the (numerical) noisy and oscillating datas of $\dot{I}_1$, are replaced by the values of the smoothed regression-parable. The range for this replacement must in any case be larger (retrospectively in time), than the number of times-steps defined by the "Delay", because the smoothing-procedure must cover the classical computation without yoke-delay in the same way, as the FPSIF-computation with yoke-delay. Thus, the range for this smoothing-data-replacement spans the full range of the "Delay" plus the necessities for the retrospective observation of the oscillation. The new xy-data-pairs of the smoothed function of $\dot{I}_1$ can now be printed (optionally) to the screen by the use of the lines 171-175 (being commented out in appendix 9.2).

This was the smoothing-procedure for the function of the time-derivative of the primary current. The same smoothing-procedure is also applied onto the time-derivative of the secondary current. This begins from line 176 on, and it works absolutely in the same way as the smoothing-procedure for the primary current, namely as following: Display of the xy-data-pairs for the smoothing-range, assignment of the $\dot{I}_2$ -data to the xy-data-arrays (which have to be provided to the smoothing-procedure), computation of the sums and the parable-coefficients, option for the display of the regression-parable, transfer of the smoothed xy-parable into the $\dot{I}_2$ -data (xy-data-pairs of the function $\dot{I}_2$), ready. Now both time-derivatives of both electrical currents are smoothed.

Supervision of disturbing oscillations:

If we follow the source-code sequentially, the next subroutine we find, and which we want to discuss in detail, is the "Function aufschaukelt". Its task is to observe, whether the time-derivatives of the electrical currents begin to oscillate (or to make random numerical noise) more than acceptable/permissible. The problems of oscillations begins with small numerical noise, which builds up during time, until finally the functions begin to oscillate tremendously. Euler's polygonal method has the problem (same as many numerical iterative solvers for differential-equations), that non-predictable and non-controllable numerical noise in one (time-)step of the computation, leads to the artefact of an enhanced gradient in the function, which is compensated directly at the next (time-)step of computation. But this compensation is to be compensated again, and so on… The consequence is, that during the course of many computation-steps, the noise begins to amplify itself extremely much (and regularly by the length of this time-steps defining the period-length of the regularity), so that the amplitudes of the artificial oscillation will become much larger (by several orders of magnitude larger), than the values of the function themselves, so that the noise and oscillations make the results useless. Because the problem begins at the time-derivatives of the functions (and not at the functions themselves), at the very

beginning of the oscillation, the problem only disturbs the time-derivatives, and not the functions themselves (because the integration-step coming from the time-derivatives to the functions themselves does a smoothing in any case).

Because the numerical noise is very small, and because it begins only in the very last decimal places, the disturbing artificial oscillations begin with very small amplitudes. Of course, the noise remains small during the whole computation (for it is only numerical noise), but the oscillations, which are following as a consequence of the noise, are amplified from step to step, and this is a feature of the solving-method (for the differential-equation). Of course, this problem is occurring mainly at the time-derivative, and at the beginning it is not very strong at the function itself, because also the integration from the time-derivative to the function, has a smoothing effect (as it quite normal for an integration). From there it is obvious, that the most easy way to determine the beginning of the (noise-initiated) oscillation, if we look not to the function, but if we look to the time-derivative. And as soon as this time-derivative begins to oscillate regularly and systematically (and more strong), the control subroutine "Function aufschaukelt" will give an accordingly message. Therefore, the subroutine "Function aufschaukelt" is activated by the main-program in regular distances (from time to time), in order to observe, whether the smoothing-procedure is already recommendable (to be done) or not yet.

This control subroutine "Function aufschaukelt" begins at line 248 with the usual program header of a subroutine. Among others, the declaration of the variables contains the declaration of "μ" (mü) for the arithmetic mean value and "σ" (sigma) for the standard deviation, whereas these both values refer to the mean value and the standard deviation of the function, along a not too long range of the function (of which the length was explained above). With regard to the extreme large number of computation-steps in the differential-equation-solver, this "not too long range" can contain some hundreds or some thousands of xy-data-pairs. If the course of the function goes somehow smooth, the gradient of the function (same as the gradient of the time-derivative) have the consequence, that the standard-deviation of the function-values is not absolutely identical zero (at least due to the curvature of the function), but the problem of disturbing oscillation begins in the moment, when the standard-deviation begins to become large – and this is fortunately the case, long before the oscillation of the time-derivative begins, to cause any oscillations in the solution-function itself. This makes it sensible, to use the standard-deviation of the y-values of the time-derivative, to measure whether the artificial oscillation comes already into a disturbing range, or not. And this is just, how the oscillation control subroutine "Function aufschaukelt" is working – nothing else but only the mere control of the standard-deviation of the y-values of the time-derivative.

We continue our discussion by explaining how this task was realised in the program (appendix 9.2), and this realisation begins at line number 253. At this line, the very first begin of the task is an optional (commented out) display of the raw values for the computation of the arithmetic mean value and the standard deviation on the screen. Printed on the screen are those xy-value-pairs, on which the smoothing-procedure is working, this is the length (in time) of "Glättungsstrecke" plus "Delay". Regarded are the xy-value-pairs of the time-derivative of the primary current. The display being commented out, goes up to line number 258. From line number 259 up to line number 263, the computation of "μ" and "σ" is following. The computation uses the usual standard formulas and thus it is self-explanatory, as written in equation (N28). Line number 264 contains the option for the display of the numerical values of "μ" and "σ", also being commented out in the source-code according to appendix 9.2.

$$\mu = \frac{1}{n}\sum_{i=1}^{n} x_i \qquad \sigma^2 = \frac{1}{n}\sum_{i=1}^{n}\left(\mu - x_i\right)^2 \qquad \sigma = \sqrt{\sigma^2} \tag{53}$$

The lines number 265 and 266 have the task to perform a simple and robust evaluation of the standard deviation "σ", from which it shall be recognised, whether the noise respectively the oscillation of the time-derivative is already large enough, to make the smoothing-procedure necessary. We presume (line number 265), that this is normally not the case, and that the smoothing-procedure has to work only in these very few cases, when the oscillation-control-procedure gives alarm. Consequently, the necessity to call the smoothing-procedure (call it: "yes" or "no" ?) which is stored in the Boole'ian parameter "merk", gets the default value of "false", and "merk" will only be set to "true", in those cases when the smoothing-procedure must be called. This last mentioned case does occur (see line number 266), when

the absolute value of the standard deviation "σ", reaches or exceeds a certain percentage of the absolute value of the arithmetic mean value "μ". Only in this case, the necessity to call the smoothing-procedure is being set to "merk:=true". The amount of this certain percentage is an input-parameter, being stored under the name of "SchaukelSensibilitaet", which is among the group of the "real" input-parameters of the program, and which has thus to be given to the program by the user, during the phase of initialisation.

The remainder of the "Function aufschaukelt" (in the lines 266-270) only has the task to transfer the Boole'ian parameter "merk". This parameter must be visible outside the "Function aufschaukelt", because the smoothing-procedure is being called up from the central core of the solver-loop, namely directly after the "Function aufschaukelt" tells the solver-loop, whether the smoothing-procedure shall be called up, or not. After this description of the "Function aufschaukelt", we want to turn our attention to the next subroutine (in the source-code).

The Signal-generator:

Of course our transformer needs an input-voltage, in order to become the ability to work at all. Thus we regard the transformer as described up to now, only as a "over-unity"-device, but not as a "self-running"-device, because it cannot be supplied completely from ZPE-energy (according to the considerations as explained up to here). The required voltage-pulse-signals are generated by the "Function Uext", and they are realised (and given to the main program) as values of the data-type "Real" (with the physical unit of "Volts"). The "Function Uext" is beginning at line 271 with the usual program-header and the typical declaration of the variables, among which there is one variable named "Frequ" giving the frequency of the voltage-pulse-signals, whatever shape they have. The corresponding angular frequency is stored in the variable named "omega".

If we for instance want to supply a sinus-shaped alternating voltage, we use of the program lines 276-278, which produce a sinus-shaped voltage signal with an amplitude of 1.0 Volt and a frequency of "Frequ". If the "Function Uext" shall bring the sinus-shaped voltage signal (parameter "merk") to the output, the lines number 279-281 are commented out, so that the value of the sinus-shaped voltage ("merk") is given directly to the Output of "Uext", from where it is transferred to the main program.

But in the other way, if we want to have a single rectangular-shaped voltage-signal, we do not comment the lines 280 and 281 out, so that line 280 deletes any former values from the voltage-parameter and makes the voltage just equal to "ZERO". This voltage level "low" is being kept everywhere, besides in this restricted range, which will be set to "high" in line number 281. In our example, the value of "high" (the amplitude) is again 1.0 Volt, and the beginning as well as the end of the restricted range with level "high" is being defined as the a specified percentage of the total interval of the time for the complete computation. For instance at the example of appendix 9.2, the voltage level is being switched to high (1.0 Volts) at the moment, when the time reaches 10% of the total computation-run, and the voltage is switched back down to "low" at the moment, when the time reaches 60% of the total computation-run.

The graphical display of such a signal is being printed in Fig.35a, at which the total duration of the computation-run is 3.0 seconds, so that the voltage is switched up to 1.0 Volt at the time t=0.3sec., and switched back down to 0.0 Volt at the time t=1.8sec.

The remainder of the „Function Uext" (lines 282-283) as usual, has the task to transfer the output-parameter (here the voltage from the parameter "merk") to Uext.

Of course it is no problem, to provide arbitrary other signal-shapes. Therefore, it is only necessary to insert the accordingly signal-function into the signal-generator "Uext". The wish to have the possibility, to generate any arbitrary signal, is the real reason for the decision, to provide the electrical input-signals for the transformer, by an own subroutine, and to leave all parameters for the input-signal within this subroutine (and not within the initialisation-part of the main program). Thus the subroutine "Uext" is the only part of the program, which works without any parameters from the main program, so that the alteration of the voltage-signal can be done completely within the subroutine "Uext" and does not require any actions, within any other part of the program.

Specification of the Input-Parameters:

This is the task, with which the main program begins, namely the part of initialisation (see from line 285 on). In addition to the overview explanations from section 6.3, we now want to explain (as promised above) the meaning of all variables in use.

The physical (geometrical) dimensions of the coils: The number of windings does not require any explanations, the length and the radius of the coils is graphically illustrated in Fig.37. Also these variables are self-explanatory, same as the diameters of the wires „DD1“ and „DD2“ used for the primary coil and for the secondary coil.

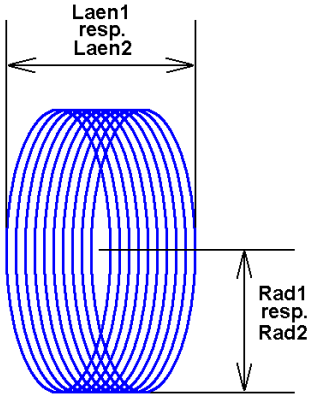


Fig.37
Graphical illustration for the convenient description of the geometrical parameters of the coils, which are “real” input-parameters for the program to simulate a motionless ZPE-converter, working according to the FPSIF-conception.

The cross-section area of the yoke “A” tells us (as its name says) the size of the active cross-section area, which is available for the transportation of the magnetic flux from coil to coil. Of course, the value of “A” depends on the geometrical shape of the yoke. For the future development of the algorithm, it might probably become interesting, to treat the cross-section area of the yoke and the cross-section area of the coils separately, and to analyse all these separate dimensions, how they influence the behaviour of the transformer. For the principle fundamental explanation of the operation-mode of a motionless ZPE-converter (as being presented here in the preceding paper), it is quite sufficient to use one single variable, to represent all cross-section areas with the same value.

For a torus-ring, the cross-section area of the yoke should be found rather intuitively and easily, but for other (also widespread) transformer-geometries, it will be probably recommendable, to use manufacturer’s data, or to determine values by practical laboratory measurements. Among the properties of the yoke, we also have the material constant „μ_r“=mur, which is known under the name of “relative permeability”. Unfortunately, this is not really a material constant, but it depends on the frequency of the alternating-current and the alternating-voltage, with which the transformer transfers magnetic flux through the yoke. In praxis, this dependency is expected to give a remarkable (crucial) limitation to the power and to the power-density of a motionless FPSIF-converter on the basis of an electrical transformer.

Also among the properties of the yoke, we have the parameter of the “Delay” which has been introduced in order to represent the runtime of the magnetic flux, passing the yoke. The parameter tells us, how much time is passing by, from the moment when one coil introduces a magnetic pulse into the yoke, until to the moment when this magnetic pulse reaches the other coil. Real effective values for this parameter are not known up to now (electrical engineers do not care about this parameter “Delay”), and they cannot be determined theoretically, but they have to be measured practically in the laboratory. Of course, the values for the “Delay” depend strongly on the dimensions of the yoke, but they should also depends seriously on the choice of the yoke-material. Especially with regard to the geometry of the yoke, we remind to Stefan Marinov, who developed a very special shape for his yoke, in order to make his motionless-converter work (and to optimize it) as it was mentioned at the beginning of section 6. He mounted a little slot and at an other position a small permanent magnet in his yoke, in order to prescribe the magnetic flux, which way it should run. The consequence is understandable according to the FPSIF-theory: For the magnetic flux is a running with finite propagation-speed, the length of the distance which the field has to pass, determines the value of the yoke’s delay-time.

Even if we do not yet have reliable measuring values for the "Delay"-time, we can at least determine a principle lower limit (and a lower limit is cautious estimation in our case) for this "Delay" on the basis of the theory of relativity, namely the amount of time, which the magnetic flux would need, if it could pass the yoke with the vacuum speed of light. Let us for instance consider a torus-ring shaped yoke with a diameter of D = 10 cm, and thus a circumference of U = 2πD = 62.8 cm. If the magnetic flux has to pass half of the circumference, to come from one coil to the other one, the geometrical distance which the magnetic flux has two pass, will be U/2 = 31.4 cm. At a maximum speed of propagation (in the height of the vacuum speed of light) of $c = 3 \cdot 10^8$ m/s , we come to a minimum duration for the magnetic flux to run from one coil to the other one of

$$\mathrm{Delay}_{\min} = \frac{U/2}{c} = \frac{0.314\mathrm{m}}{3 \cdot 10^8\,\mathrm{m/s}} \approx 1.05 \cdot 10^{-9}\mathrm{sec.} \qquad (53)$$

This anyway a bit more than a Nanosecond, and thus rather good compatible with our example from equation (N26). This makes the expectation absolutely realistic, to convert ZPE-energy with an electrical transformer according to the FPSIF-principle. And if we keep in mind, that the propagation speed of the magnetic flux in real existing yoke material, is probably remarkable slower than the vacuum speed of light (especially with large μ_r), a remarkable enhancement of the converted power in comparison to the example presented above, is to be expected in any case, especially because the converted power increases directly as a function of the delay time.

With regard to the μ_r , it should be noticed that the speed of light in material (as the propagation speed of electromagnetic waves as well as of electric and magnetic fields), is being calculated according to

$$c_{Mat} = \frac{1}{\sqrt{\mu \cdot \varepsilon}} = \frac{1}{\sqrt{\mu_0 \cdot \mu_r \cdot \varepsilon_0 \cdot \varepsilon_r}} \text{ , leading to } c_{Mat} \propto \frac{1}{\sqrt{\mu_r}} .$$

With a view to the "Delay", we now reached the program line 295, thus we will go further on to line 296. For the solution of the differential-equations, the Ohmic loads in the primary circuit and in the secondary circuit are important (power losses), but it is not important to ask, how these loads can be split into loads of consumers, Ohmic loads of coils, Ohmic loads of wires and other energy sinks. Thus, we take all energy-losses and power-losses together, in as few real input-parameters as even possible, this is R1 for all losses in the primary circuit, and R2 for all losses in the secondary circuit, both in good agreement with Fig.34. For the principle operation of the ZPE-energy-converter, it is not necessary to ask about the apportionment of all Ohmic losses, due to the individual reason for each loss.

In line number 297 the time-interval for the total time-duration, over which the solution-function has to be determined, is written. We always make the timescale start at the begin of our computation, this is the very first moment of time "tanf = 0". The length of the time steps „dt" (per each step of iteration) is a parameter, which has been discussed rather much already, so that we do not have the necessity to give furthermore explanations now. But, because of the crucial importance of this parameter "dt", it should be emphasised again, that the certainty/uncertainty of the computation crucially depends on the fact that "dt" is chosen as small as possible (with respect to the CPU-time that can be elapsed for the computation). Of course, it is not practicable to wait for each single to computation-run several hours or several days, when we want to develop a practical product design of a motionless FPSIF-converter in future. The moment of time for the end of the computation-time interval "tend" could in principle be fixed at the end of one period of the periodic signal of U_{ext} , because a repetition of more (several) periods would be redundant. But of course, when (later) developing a practical design for a prototype, we will have to care about the time for transient oscillations, so that the system gets the necessary time to start and to end its oscillation required for proper operation (not to confuse with the time of disturbing artefact-oscillations). Probably this restriction makes it necessary, to supply a "waiting-time-interval" (as plotted in Fig.35), and furthermore it can be interesting to include a second or maybe even a third period of the U_{ext}-signal into the computation, in order to analyse how the system behaves in the time between the signal-pulses (and during the transient phase). Such an analysis might be necessary to find out, how far the frequency of the U_{ext}-signal can be enhanced, in order to keep the motionless-FPGW-converter in (long term) stationary operation.

The lines number 298-301 do not require much explanation, because the specific resistance of the copper wire is self-explanatory, and the parameters of „SchaukelSensibilitaet“ and „Glaettungsstrecke“ have already been explained within the discussion of the “Function_aufschaukelt“ and the “Procedure Glaettung“.

Affiliated Parameters:

The “real” input-parameters are now discussed, and we want to turn our attention to the “affiliated” parameters, which have to be derived from the “real” input-parameters. They are necessary for the operation of the algorithm, and they will be calculated automatically by the computer program. During the development of the program, I took care that there are no affiliated parameters among the group of the real input-parameters, because this would bring the problem of redundant data-input, causing the risk to generate inconsistencies (and contradictions) in the set of parameters.

Because in our program, the possibility of inconsistencies and contradictions is given already in the set of the real input parameters, an automatic control was made to check whether there are inner contradictions within the set of the real input-parameters. And if such a contradiction is found, the program is terminated immediately, as soon as the contradiction is existing. This consistency-check is made in the lines number 303-319, namely as following: From the geometry of the coils and the thickness of the copper wires from the coils are made, we can calculate the Ohmic resistances of the coils’ copper wires, and we do this separately on the one hand for the primary circuit, and on the other hand for the secondary circuit. If minimum one of the Ohmic resistance values of a coil, is larger than the total Ohmic load in the according circuit, the dimensions of the coil are obviously in contradiction with the value of the according Ohmic resistance, because the total power-loss of a circuit can never be smaller, than the Ohmic power-loss caused only by the coil within this circuit. Of course, the total power loss in every circuit must always be larger, than the mere Ohmic power-loss of the (coil’s) copper wire, of this circuit.

In order to check these inconsistencies, and to terminate the program in case of any inner contradictions, the lines number 303 and 304 have the tasks, to calculate the mere Ohmic resistances, of the coils’ copper-wires. In line number 305 we calculate the difference between the total resistances in each circuit and the mere Ohmic resistances, of the coils’ copper-wires in each circuit. This difference defines the amount of energy-loss (and power-loss) which can be regarded as a sub-summation of all consumers and all energy-sinks beside the coils. We regard this difference as a general sub-summation of all Ohmic resistances besides the coils, and we call it “consumer’s resistance”. And the values of these consumer’s resistances must positive in any case, in the primary circuit as well as in the secondary circuit. A negative consumer’s resistances would simply be nonsense, so that it would be useless, to continue the program with such parameters. In line number 306, the values of the Ohmic resistances of the coils’ copper wires (calculated from the geometrical parameters of coils) are printed onto the screen. The termination of the program in the case of negative consumer's resistance is done in the lines number 307-318, together with an error-message being brought to the screen. Only in the case, that all consumer’s resistances have positive values, the program continues its run as it should do, namely from line number 319 on, where it prints the positive values of the consumer’s resistances onto the screen. Now, the program is ready to begin its work on the solution of the differential-equation-system, and this this just what will follow after some further preparations, which are described in the following lines.

The lines number 320-326 have the task to calculate the inductances according to the equation (36) and (37), and then to print their variables onto the screen.

Also understandable without many explanations are the lines number 327-336, which have the task of initialisation of the variables for the central core of the solver. At first the values for the electric currents and their derivatives are set to zero, as starting values for the numerical iterative computation. These are I1, I1p, I2, I2p – where the index “p” (for “point”) stands for the time-derivatives. Beginning the currents and their time-derivatives with “zero” has the purpose to ensure, that at the very beginning, there is no energy inside the system.

The next task of the program is, to store the electrical currents and their time-derivatives retrospectively, for a certain time-interval. This is necessary, that we can later take the yoke-delay into account, and furthermore it has the additional purpose, to keep the data (if necessary) for the smoothing-procedure. The initialisation of the values for the energy-balance-computation, and for the data-evaluation of this energy-balance-computation is done in the lines 334 and 335.

From line number 337 on, the solution-process of the differential-equations begins, namely in line 338 with the determination of the total number of steps of calculation, which are necessary according to the real input-parameters. This total number of calculation-steps can be so large, that data-type “Int64” had to be chosen for this variable, in order to avoid a data-overflow.

The lines number 339 and 340 do not have any task regarding the solution of the differential-equation, but they only have the purpose to estimate the expected computer-time for the calculation, so that the user can have a feeling how long she or he should wait for the result. There are some funny values in line 339, which go back to practical tests, how much time the program needed during the phase, when the algorithm was developed. The values have been taken with a stopwatch empirically, but there have been lots of optimisations of the algorithm, so that the time-estimation is not correct any further. Additionally it should be mentioned, that the time-estimation changes from computer to computer, so that the user of the algorithm cannot rely on the values in appendix 9.2. Therefore I decided, not to adapt the parameters for the time-estimation any further, because they alter from computer to computer. This is also the reason, why I decided not to display the time-estimation on the screen any further. Thus, the lines for the time-estimation are in principle useless now, but nevertheless, I did not remove them, in order to give the reader the possibility, to activate the time-estimation (if you wish) after doing your own “elapsed-tests” with a stopwatch.

The lines number 341 and 342 have the purpose, to restrict the volume of data, which are selected for the Excel-data-file (that shall be created later), to very few lines (namely to few thousand lines). It is utterly impossible, to export all calculation-steps to Excel, which the solver produces, because these are millions or billions of lines, far too much for any data-processing in Excel. And it would be completely senseless to export so many data into the Excel-program, because the Excel-graphic will not be able, to print so many pixels to any screen or printer. And nobody would be able to observe so many pixels with her or his eyes. Consequently I decided to restrict the volume of data, that are allowed to be exported to Excel to “ExcelMax”, which is a constant, as defined in line 7 of my Pascal-program. And the value of this constant is predefined with 5000. I decided to choose this principle upper limit for the number of lines to be exported to Excel, because this is far enough for a good graphics-processing. And this is what the lines number 341 and 342 are doing: They care about the fact, that only in equidistant distances the results are exported into the Excel-File, and not more than 5000 lines at all. Therefore, the parameter “ExcelSteps” is being calculated, which tells us, how long the equidistant distance distances between the computation-steps must be, so that Excel-file is filled in optimal way with data.

The screen-output of data in the lines 333 and 334 is self-explanatory. The lines number 345-347 have the purpose, to initialise some more variables, which are necessary for the export of data into the Excel-file.

The central core of the solver-loop:

This central loop begins at line number 348, whereas the lines number 349-355 do not have a meaning for the actual computations, because they (again) care about the estimation of the duration of the computation. Also this part of the program gives (as mentioned above due to alterations in the program, after these lines had been developed) very uncertain (unreliable) results, so that they are not brought to the screen for display. Nevertheless, every user of the program can determine the values within these lines, for her or his computer individually (using a stopwatch).

Originally, in line number 356 a counter for the central-solver-loop should start like “For I = 0 to Imax“, which ends in the line number 407. The counter has the purpose to count the computation-steps of the central-solver-loop. And this is an extremely large number, so “IMax” (the maximum number of computation-steps) must be stored on a variable of the data-type “Int64” (as explained above). The

problem was that my Pascal-compiler did not handle “For I=…“-loops with this data-type, so that the “For I=…“-loop had to be replaced by a “Repeat … Until“, which now begins in the lines number 356 and 357 (and ends at line number 407).

Line number 358 has the purpose to make the time run consecutively. Each passage of the “Repeat … Until“-loop means one time-step of the solver’s computation. And with each time step, the formerly new values (from the last time-step) of the currents and their time-derivatives, will be converted into the old ones (from the latest passed step of computation) – see line number 359. But it is not enough, to store only one single old step of computation, because the “Delay” for the FPSIF-conception needs a certain amount of (elder) time-steps (of computation) to which it can look retrospectively back (see line 360-364). These formerly computation-steps, which still will be necessary to know, must be stored.

In the lines number 365-369, the control whether the solution-function begins to oscillate (artificially) disturbingly is done, and it is enough to do this control every 10000^{th} step of computation. Whenever the control leads to the consequence, that the oscillation is already disturbing, the smoothing-procedure for the time-derivatives of the currents is performed.

The lines number 370-372 are commented out. Their task had been the screen-display of those computation-data (in retrospective view), which are important for the computation along the “Delay” according to the FPSIF-conception.

The insertion of the time-derivatives and the currents, into the differential-equation-system begins with line 373. And this must be done (according to the FPSIF-conception) with a “Delay”, so that the results which are already several (few) computation-steps old, have to be inserted into the computation-step now. The crucial question is to find, how many computation-steps back in history of computation-run we have to go, in order to realise the proper “Delay”. (Therefore, experimental measurements on the real “Delay”-time, depending on the yoke-material and yoke-shape will be necessary.) This leads to the consequence, that the next task in our program is, to search those data-points, which have the appropriate “Delay”, so that the delayed propagating magnetic field reaches the time “now” after passing the yoke due to its finite speed of propagation. This is necessary to fulfil the conditions of the FPSIF-theory, namely to apply this theory at all (see lines 374 and 375). As soon as the currents, originating from the proper moment in time (according to the FPSIF-conception) are found, they can be used in the lines number 376 and 377, for the computation of the time-derivatives, initiating the next step of the numerical iteration. This is now done with the long-discussed differential-equations (36) and (37), respectively (38) and (39).

When having the time-derivatives determined as described (from the differential-equations), the integration-step has to follow, and this is done in the lines 378-379. This is the integration over the time, which is to be understood as the computation of the actual new time-step of the solution-function (of the currents).

The lines number 380 and 381 have the task to keep the time-derivatives in a memory for future use, for instance for the next steps of the differential-equation-solver, for being present after some “Delay” (and for the smoothing-procedure).

There is also an information for the user, about the progress of the computation, which is independent from the individual computer, and which does not require any “elapsed-CPU-time-parameters” to be taken with a stopwatch. This information is realised in line number 382. Therefore, the total CPU-time for the complete computation-run (these are all computation-steps from “I = 0“ until to „I = IMax“) is being subdivided into 65 equidistant pieces. Always, when the next 65^{th} part of the computation is ready, an asterisk “ * ” is added to a line of at least 65 asterisks, so that the user can follow a line which is filled with asterisks time after time, with the knowledge that the computation will be complete, when the line will be (nearly) full.

From line 383 on, the evaluation of the energy-balance begins. Because this is one of the most prominent and important results of the whole computation at all, the values are written not only to the Excel-result-file (of course they must be there), but their results is also printed directly to the screen. The energy-computations and power-computations are performed according to the formulas (47a,b,c), which

is done in the lines 384-386, namely for the total Ohmic resistances in the primary circuit and in the secondary circuit. Analogous computations for the separation of the Ohmic losses of the copper wires forming the coils are following the lines number 387-389.

The recording procedure for all available results for the export into an Excel-file is following in the lines number 391-406. Therefore, the results are written into a file on the hard-disk, but only the results in equidistant distances of "ExcelSteps" are taken as being explained above (which is necessary because of the huge amount of raw-data).

The end of the loop of the central computation-core of the differential-equations is to be found in the lines number 407 and 408.

The results of the energy-balances (which had been calculated in the lines number 383-390) are being printed to the screen in the lines number 410-418, namely directly after the loop of central computation-core is finished, because the end of the central computation-loop is the moment, when those results are available. At this moment we can see, whether the computation-run, after passing one complete period of the signal of U_{ext} (or a multiple of the period-length) did actually convert ZPE-energy, or not – and if yes, how much power respectively, how much energy had been converted.

Also the task to write the results for the export into an Excel-file on the hard-disk (subroutine "ExcelAusgabe"), is being done after the central computation (of the differential-equations) is finished, because also these results are only ready, when the differential-equation is solved (see lines 419-428). The recording-procedure begins with an explicite question to the user, whether she or he wants to have the recording of the data, into an Excel-file, or not. This explicite question, which needs the explicite decision about a choice (write to hard-disc. "yes" or "no" ?), after every test-run of the algorithm, has the purpose to minimise the burden of the hard-disc, because it ensures, that not after every little test, the hard-disc will be stressed.

6.4. Design-development of a Motionless-Converter

After the task is now done, to transfer the FPSIF-theory of ZPE-energy-conversion, onto the system of a motionless converter (here in the example working according to the technique of an electrical transformer), the theoretical preconditions are given, to develop such a device practically, a ZPE-energy-converter without any mechanical parts in motion. Because any actual measuring-data of the propagation-speed of magnetic fields and of the magnetic flux inside the yoke-material are still missing, we do not have the situation now, that we can immediately begin with a concrete product-design of a prototype of a motionless ZPE-energy-converter. Necessary will be the determination of the FPSIF-delay as a function of the yoke-material, of the geometrical dimensions of the yoke, of electrical and magnetical parameters, and so on…

By the way, I should mention, that some physicist-colleagues doubt, that (electrostatic same as) magnetic fields propagate with a finite speed. But when speaking to me about these doubts, all of them always confirmed, that field-alterations indeed propagate with a the speed of light - in the vacuum with the vacuum speed of light, and inside material with the accordingly reduced speed of light. Because my application of the FPSIF-theory, as being used for the example of a motionless ZPE-converter here, does not require the finite propagation-speed of the field (itself), but it requires only the finite propagation-speed of the field-alterations, there is no doubt, that the FPSIF-principle will really work in the example presented here.

However, I decided to demonstrate in the further course of the preceding paper, how a concrete product design of a prototype of a motionless ZPE-converter can be developed by principle. Therefore we will introduce some arbitrary but realistic values to describe the FPSIF-delay, and we will demonstrate our computation-examples on their basis.

How we can begin with the development of a practical product design of a prototype of a motionless ZPE-converter, is shown by the following example, where we assume a material-constant of μ_r=12 (relative susceptibility) for the yoke-material – just with the purpose to vary one of the numerous parameters a littlebit into a practical direction (Dgl_Loeser_004e_ohneDelay_muer12_hochfein.dpr). The time-steps of "dt=10^{-11} sec." are for sure not yet as fine, as it should be the case for very precise results, and these time-steps do of course not yet reach the value of equation (51), but the tendency for ZPE-conversion is recognisable, and this is the important statement of physics, what I want to illustrate by the preceding example.

Due to the moderate fineness of the time-steps of the calculation, the value of the converted energy E_{FPWG} is not very much above the numerical noise in this very first example here, namely it is $\Delta E_{without\ Delay} \approx +1.416042 \cdot 10^{-7}$ Joule and $\Delta E_{with\ Delay} + E_{FPWG} \approx +1.630909 \cdot 10^{-7}$ Joule, so that the difference between both is only $E_{FPWG} \approx +1.630909 \cdot 10^{-7}$ Joule $- 1.416042 \cdot 10^{-7}$ Joule $= 0.215 \cdot 10^{-7}$ Joule, stating that there is a remarkable uncertainty in this result. Nevertheless we want to discuss the converted energy E_{FPWG} in order to develop a feeling for practical dimensions and for limitations, with regard to the technical realisation of a motionless-converter according to the principle of a FPSIF-transformer:

The stimulating voltage-pulse, as a signal example $U_{ext}(t)$ for our computation-run as described here, is printed in Fig.38. The excitation of the primary current, which is caused by this voltage-pulse, can of course due the inductance of the coils, only follow with a rapidity according to Fig.39. Of this reason, any further enhancement of the frequency of $U_{ext}(t)$ would be senseless (because the coils and the yoke could not follow more fast), and this limitation of the frequency has also the important consequence of a limitation of the power being convertible from the ZPE-energy, because the power-convertible per each pulse is given (due to the dimensions of the setup), and the number of pulses per second is limited. Same as the current in the primary coil, also the current in the secondary coil is limited by an analogous limitation, as can be seen in Fig.40, which makes clear, that the number of pulses can obviously not be enhanced arbitrarily.

When the voltage $U_{ext}(t)$ is switched on at the moment of time t=3ms, the primary coil begins to accept current, and thus to produce magnetic field and magnetic flux, which is transmitted into the yoke. And it takes several milliseconds, until the magnetic flux will have reached the value of "high", following the rectangular shape of the voltage U_{ext} = „high". Thus it is indeed sensible to wait until to the time t=15ms, until the voltage is switched back, down to "low" (U_{ext} = 0 Volt). And from now on, we have two wait additional 10 ms, until the primary current and it's time-derivative go back more or less close to Zero. The primary current is plotted in Fig.N8, where we see its inertance, and the same inertance can be seen in the current-pulse of the secondary coil in Fig.40.

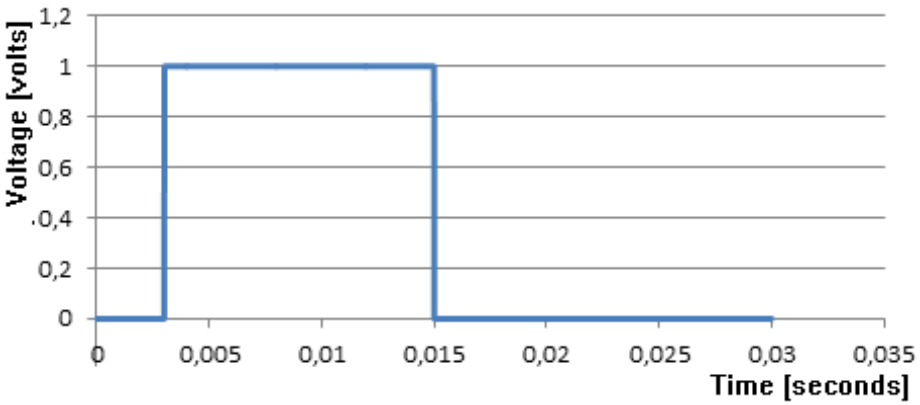


Fig.38
In the computation example reported here, the primary coil is being stimulated with a voltage-pulse $U_{ext}(t)$ as being plotted adjoining.

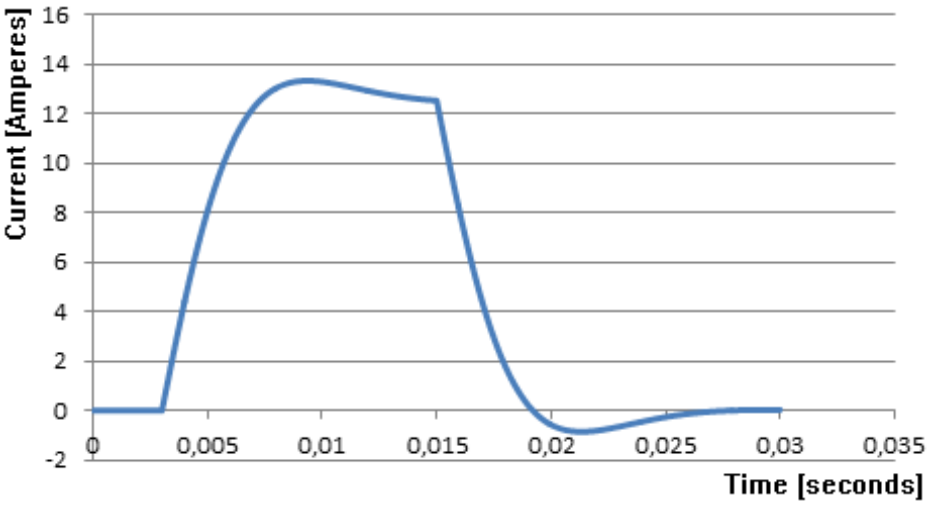


Fig.39

After stimulation with the voltage-pulse $U_{ext}(t)$ from Fig.38, the current in the primary coil is running as being plotted adjoining.

The plot refers to the example, which is reported in the text of the paper.

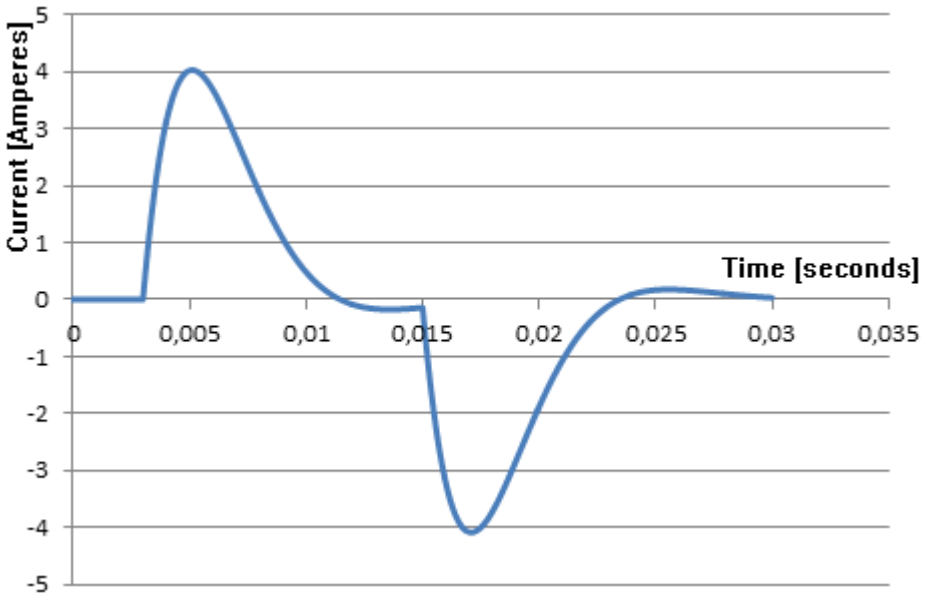


Fig.40

As a consequence of the current in the primary coil according to Fig.39, the secondary circuit experiences a current as being plotted adjoining.

The plot refers to the example, which is reported in the text of the paper.

Here we see an example for an aspect, regarding the practical design development of a ZPE-motionless-converter, at which the real conditions of the coils and of the yoke, lead to an actual limit of the working frequency of the converter. Similar and numerous (other) further practical aspects will have to be respected, as soon as somebody will begin, to compute a real product-design of a ZPE-converter explicitly. Therefore, all necessary input-parameters will have to be adjusted in such way, that they obey the practical rules of electrical engineering, with regard to practical machines. But on the other hand, the work of practical product design, will allow to get benefit from numerous additional possibilities, which are not optimised up to now, because up to now there was not yet any optimisation of the input-parameters. Thus, there will be plenty of room for a further optimisation of the converter-design; and it will be necessary to get benefit of this optimisation and its possibilities, as soon as we will have some measuring results of the propagation speed of the magnetic fields (and its alterations) in the yoke, and as soon as the parameters of the setup can be analysed experimentally in the laboratory.

Some of the physical dimensions, which can allow optimization, are the following:

- The number of windings of the coils. Besides, we should not forget that n_1 und n_2 can be adjusted separately and individually.
- The thickness of the wire from which the coils are made; it influences the inertness of the coils (the inductance), but also the Ohmic losses.
- A variation of the consumer resistances; this allows the maximisation of the useful power-output, that can be extracted from the system.

- A variation of the voltage-signal-shape of $U_{ext}(t)$; this allows especially many possibilities and has a great scope for design alterations. Finally, also an adjustment (maximisation) of the signal-frequency to the requirements of the coils and the yoke will have to be regarded together with these aspects. Unipolar signals are imaginable same as, as bipolar signals. An important role will also play the signal height (amplitude).
- If capacitors can be added to the circuit (in the primary- as well as in the secondary- circuit), they allow the signal and its energy to oscillate back and forth, between primary and secondary circuit (see Fig.41). It is to be expected (visionary), that such capacitors should create the possibility, to further develop the motionless transformer-converter into a self-running device (being completely supplied from ZPE-energy). As long as it is necessary, to insert permanently electrical energy via $U_{ext}(t)$, keeping the device running in a mode, that more classical (electrical) energy can be extracted (via the consumer-resistances) then is inserted, the engine is only an "over-unity" device. But as soon as it is possible, to make energy oscillate back and forth between the primary and the secondary circuit, using capacitors to fulfil this task, the oscillating pulse can be enhanced from ZPE-energy, at each passage through the yoke (which causes the "Delay" responsible for the ZPE-energy-conversion). And if it is possible, that the pulse runs back and forth, and back and forth, and so on…, and will be become stronger and stronger each time when it passes the yoke, the device will begin to work as a self-running engine, as soon the energy gain from ZPE-energy-conversion is larger than the losses in the wires, in the coils, in the yoke and the in capacitors and due to stray-fields, and in other energy-sinks, …
- A variation of the geometrical dimensions of the coils and of the geometrical dimensions of the yoke. Even the cross-section area of the yoke can be different on the primary side, from the cross-section of the yoke on the secondary side.
- The search for an optimum yoke material, especially with regard to μ_r and with regard to a maximisation of the delay, with other words: Goal is the minimisation of the propagation speed of the magnetic fields (and its flux) within the yoke material. This is of course an extremely important parameter for an optimization of a practical prototype.
- The list of possibilities for optimisation can be prolonged remarkably. Also the size of the yoke plays an important role, because it determines the propagation-distance, which the magnetic fields inside the yoke have to pass. This provides a good possibility, to enhance the delay-time of the yoke strongly, even if the propagation-speed of the field in the yoke material could not be reduced too much. Due to this reason, a geometrically large setup, should be realisable more efficient (and easy) than a geometrically small setup (because the fields have to pass a long distance within a large yoke), so that the dimensions of an engine can be scaled up much easier than be scaled down.

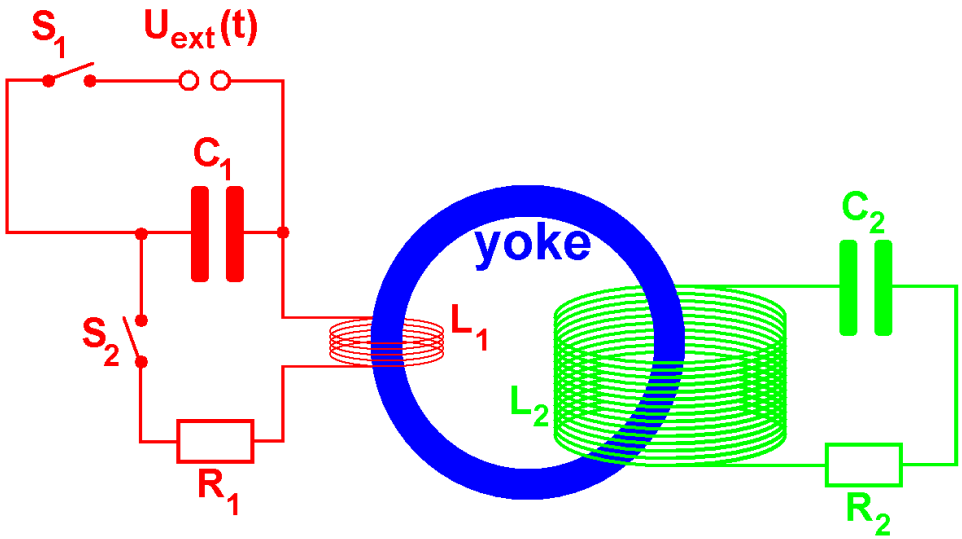


Fig.41

Suggestion for the further development of a motionless "over-unity" device according to Fig.34, into a "self-running" device, which will be supported completely by the zero-point-energy of the quantum-vacuum.

Continuating perspectives:

- **The material of the yoke** takes influence on to the speed of light via the parameter of the relative permeability μ_r. As well known, according to the rules of electrodynamics, the speed of light is given as

$$\text{vacuum speed of light:} \quad c_V = \sqrt{\frac{1}{\mu_0 \cdot \varepsilon_0}}$$
$$\text{speed of lightg in the material:} \quad c_{Mat} = \sqrt{\frac{1}{\mu_0 \cdot \mu_r \cdot \varepsilon_0 \cdot \varepsilon_r}} = \frac{c_V}{\sqrt{\mu_r \cdot \varepsilon_r}} \qquad (55)$$

We do not yet know properly the rule of the relative permittivity ε_r under our circumstances (with regard the propagation speed of the magnetic field). Clear is, that μ_r is definitely important, especially when we keep in mind, that there are some very special materials, with surprisingly large values of μ_r. So we can find for instance in [Ber 71] μ_r – values up to several 100000. For these values depend strongly on the prehistory of the material, and for sure also on the frequency of the signal, we cannot simply assume, that the speed of light in the material might be reduced by two or three orders of magnitude, relatively to the speed of light in the vacuum. But we can hope, that the propagation-speed of the fields in the yoke, might be much slower than in the vacuum, and so the field-"Delay" in the yoke might be enhanced remarkably, and with it the amount of power, which can be converted from the ZPE-energy.

- **The additional inclusion of capacitors** (according to Fig.41) in both circuits (one capacitor in the primary circuit as well as one capacitor in the secondary circuit), gives the possibility, to initialise the system with one starting voltage-pulse from U_{ext} , and then to make the pulse oscillate between the capacitors, so that the system runs completely driven by ZPE-energy-supply. The starting procedure can be the following (see Fig.41): Switcher S_2 is open at the beginning of the starting procedure, and S_1 is closed, so that we now use U_{ext} to load the capacitor C_1. When the capacitor C_1 is loaded, the switcher S_1 has to be opened, and after it is open, the switcher S_2 has to be closed. Consequently, the capacitor C_1 unloads itself via L_1 , so that the primary circuit is in principle an LC-oscillation-circuit. From now on, it is not necessary, to insert any further energy via U_{ext}. De facto, the primary LC-oscillation-circuit is connected via the yoke with the secondary LC-oscillation-circuit, so that unloading of C_1 causes an electrical current not only in the coil L_1, but also in the coil L_2, and thereby of course also in the secondary circuit. The electrical charge oscillates from the capacitor C_1 into the coil L_1 , where the electrical energy is being converted into a magnetic field (magnetic field-energy), passing the yoke, coming into the coil L_2 . The coil L_2 converts the magnetic field-energy back into an electric current (see: law of induction), which charges up the capacitor C_2, and from there, the same procedure goes the same way back, until the energy is back in the capacitor C_1. The complete system forms two LC-oscillation-circuit, which are coupled with each other, and which follow the requirements of the FPSIF-conception, namely because of the runtime(-Delay) of the magnetic field (signal) when passing the yoke. The FPSIF-conception makes the system capable to convert ZPE-energy, and when the electrical/magnetic signal runs back and forth, with every cycle it will be enhanced by ZPE-energy. The problem is the necessity, to find the appropriate adjustment of the system-parameters, which allow this mode of operation. And that (system-parameter adjustment) will be a question of technical cleverness (under the help of the design-development software, which is presented in the preceding article).

The differential-equations of the complete coupled system (including the capacitors) are written in formula (56). They originate from the differential-equations of the accordingly system without capacitors (mesh rule, from equation (28)), which have now been expanded by the terms (voltages) describing the capacitors. These voltages are U_{C1} und U_{C2}.

$$\text{mesh rule:} \quad Uext(t) + U_{R1} + U_{L1} + U_{C1} = 0 \qquad (\text{in the primary circuit})$$
$$U_{R2} + U_{L2} + U_{C2} = 0 \qquad (\text{in the secondary circuit}) \qquad (56)$$

For the capacitances are to be written according to equation (57), this leads in the very last consequence to the fact, that the order of each differential-equation is enhanced by one, and thus the order is enhanced for the whole differential-equation-system by two.

$$\left.\begin{array}{l} C=\dfrac{Q}{U_C} \;\Rightarrow\; U_C=\dfrac{Q}{C} \\ I_C=\dfrac{\partial Q}{\partial t} \;\Rightarrow\; Q=\int I_C\cdot dt \end{array}\right\} \;\Rightarrow\; U_C=\frac{1}{C}\cdot\int I_C\cdot dt \tag{57}$$

If we put the voltage U_C according to equation (57) into the differential-equation-system (56), and use all other expressions (for the coils, capacitors and U_{ext}) as they are written in the differential-equation-system (30) analogously, we come to:

$$\begin{array}{l} Uext(t)+R_1\cdot I_1+L_{11}\cdot\dfrac{\partial I_1}{\partial t}+L_{12}\cdot\dfrac{\partial I_2}{\partial t}+\dfrac{1}{C_1}\cdot\int I_{C1}\cdot dt=0 \quad (\text{in the primary cicuit}) \\ R_2\cdot I_2+L_{21}\cdot\dfrac{\partial I_1}{\partial t}+L_{22}\cdot\dfrac{\partial I_2}{\partial t}+\dfrac{1}{C_2}\cdot\int I_{C2}\cdot dt=0 \quad (\text{in the secondary circuit}) \end{array} \tag{58}$$

U_{ext} can perhaps be completely switched off, or (and this might be the preferable way for the practical development of the computation-program) it can be supplied as one single voltage-pulse, which is given to the system only once, and is short in duration, in order to emulate the actuation of the switches "S_1" and "S_2" (without arising the necessity to introduce any switches into the algorithm of the differential-equation-solver). Such a short pulse of U_{ext} , which inserts energy into the primary circuit, can be typically used, in order to initiate the work of the "**S**elf-**R**unning **M**otionless **Z**PE-**T**ransformer" (let us choose the abbreviation "SRMZT" for such a system), i.e. to start its operation.

Due to the fact, that the equation-system of (58) contains time-derivatives as well as integrals, we can replace the electrical currents by electrical charges (following the usual definition of the electrical current $I=\partial Q/\partial t$), in order to bring the differential-equation-system into the habitual form (containing only derivatives and no integrals):

$$\begin{array}{l} Uext(t)+R_1\cdot\dfrac{\partial Q_1}{\partial t}+L_{11}\cdot\dfrac{\partial^2 Q_1}{\partial t^2}+L_{12}\cdot\dfrac{\partial^2 Q_2}{\partial t^2}+\dfrac{1}{C_1}\cdot Q_1=0 \quad (\text{in the primary cicuit}) \\ R_2\cdot\dfrac{\partial Q_2}{\partial t}+L_{21}\cdot\dfrac{\partial^2 Q_1}{\partial t^2}+L_{22}\cdot\dfrac{\partial^2 Q_2}{\partial t^2}+\dfrac{1}{C_2}\cdot Q_2=0 \quad (\text{in the secondary circuit}) \end{array} \tag{59}$$

If we decide to solve the equation-system (59), we would get $Q_1(t)$ and $Q_2(t)$ as solutions, and from there it would be easy, to come to the currents $I_1=\dot{Q}_1(t)$ and $I_2=\dot{Q}_2(t)$, just simply by calculating the time-derivatives of the solutions $Q_1(t)$ and $Q_2(t)$.

All those, who like the notation in current functions $I_1(t)$ and $I_2(t)$ better than the notation in charge-functions $Q_1(t)$ and $Q_2(t)$, may derive the whole equation-system (59) once to the time (where all $Q(t)$ have to be replaced by $I(t)$), which leads us to the notation of (60). Nevertheless, this notation has the disadvantage, that all voltages (and so also the external initiating voltage U_{ext}) have to be written as their time-derivative (because the whole equation was put under the operation of derivative):

$$\begin{array}{l} \dfrac{\partial Uext(t)}{\partial t}+R_1\cdot\dfrac{\partial I_1}{\partial t}+L_{11}\cdot\dfrac{\partial^2 I_1}{\partial t^2}+L_{12}\cdot\dfrac{\partial^2 I_2}{\partial t^2}+\dfrac{1}{C_1}\cdot I_1=0 \quad (\text{in the primary cicuit}) \\ R_2\cdot\dfrac{\partial I_2}{\partial t}+L_{21}\cdot\dfrac{\partial^2 I_1}{\partial t^2}+L_{22}\cdot\dfrac{\partial^2 I_2}{\partial t^2}+\dfrac{1}{C_2}\cdot I_2=0 \quad (\text{in the secondary circuit}) \end{array} \tag{60}$$

Because also in the system of Fig.41 and the differential-equation (56)…(60), all magnetic fields have to pass the yoke with a (certain) time-delay according to the FPSIF-theory, all those summands, which have to pass the yoke, have to be inserted into the numerical iterative solver-algorithm with the accordingly

"Delay". These are the summands $L_{12} \cdot \frac{\partial^2 I_2}{\partial t^2}$ and $L_{21} \cdot \frac{\partial^2 I_1}{\partial t^2}$ (the mixed coil's coefficients), namely the coupling of each differential-equation to the respectively other one, because this is exact the coupling, which is transferred via the yoke.

6.5. The way from "over-unity" engine to a "self-running" device

The setup as being described up to now in Fig.34 and in the sections from 6.1 up to 6.4 is only an "over-unity"-setup, because it has to be supplied with external electric power, which is inserted via the voltage-generator $U_{ext}(t)$ into our differential-equations. The differential-equation-system can be seen in (30) respectively in (36) and (37).

The way from there to the "self-running" device can be achieved by following Fig.41, which can be operated after being initiated with a single energy impulse, being inserted into the system once (in this example it is electrical energy), which runs (oscillates) permanently back and forth within the system, so that it can be enhanced out of ZPE-energy at each passage of the yoke, being done with FPSIF time-delay. In the special example of Fig.41, this is being done by converting the energy of the impulse permanently back and forth between electrical and magnetical field energy (this is the task of the coil), and by giving the FPSIF-time-delay to the magnetic impulse via the yoke. For this purpose, both coils of the transformer have been inserted into an LC-oscillation-circuit, as it is being drawn in Fig.41. The differential-equation-system for this setup, is written in (58) respectively in (59). By nature, this system is more complicated, than the differential-equation-system according to (30), (36), (37). The most important difference between simple differential-equation-system **without** the capacitors and the new more complicated differential-equation-system **with** the capacitors is, that the order of each differential-equation within the system is enhanced by **one** due to the capacitors. This means, that due to the capacitors, we now have a system of two differential-equations, of which both have second order, i.e. the whole system is of fourth order.

Convenient is, that despite the higher order, the solution of the differential-equation-system can be calculated with the algorithm developed in the sections 6.1 … 6.4, if we perform a rather moderate alteration of the equation-system. The most easy way therefore is, to record the both integrals of (59) $\frac{1}{C_1} \cdot \int I_{C1} \cdot dt = \frac{1}{C_1} \cdot Q_1 = U_{C1}$ $\left(\text{in the primary cicuit}\right)$ and $\frac{1}{C_2} \cdot \int I_{C2} \cdot dt = \frac{1}{C_2} \cdot Q_2 = U_{C2}$ $\left(\text{in the secondary circuit}\right)$ directly during the numerical iterative computation, step by step, when the solver-loop of the differential-equation is running. This means, that we have to record the electrical charge carriers flowing for $\Delta Q_1 = I_{C1} \cdot \Delta t$ resp. $\Delta Q_2 = I_{C2} \cdot \Delta t$ always directly in the moment, when the charge carriers are flowing. If we do this, we always have directly during each computation-step, immediately always the knowledge of the capacitor-voltages $U_{C1}(t)$ and $U_{C2}(t)$, and thus we can insert these voltages directly at each computation-step, into the numerical iterative solving routine. This makes the handling of the differential-equation-system most easy and convenient, because we only have to record the flowing electrical charge (the charge-flux) and then to perform the simple addition of the charge (in flux), divided by the capacity of the capacitor in equation (59). By this simple means, the required integration-step, which is necessary due to the higher order of the differential-equations, is reduced to the simple integration of the electrical charge flowing into the capacitor and out of the capacitor, because the capacitor is a storage for electrical charges, and thus the charge is responsible for the voltage of the capacitor. This means that the differential-equation-system of fourth order (2+2) is reduced to a rather handy integral-equation, which can be solved with the solver-core, which already has been developed for sections 6.1 … 6.4.

The realisation of this algorithm was done in the source code of "Dgl_Loeser_005.dpr" (and in variations of this source, with different attached characters at the end of the file-name). The extensions, which have been added to the original source-code of the sections 6.1 … 6.4, are written in appendix 9.2 in green colour, namely the new (additional) green lines are written in between the lines of

"Dgl_Loeser_004c.dpr". The additionally added green lines do not exist in "Dgl_Loeser_004c.dpr", but only in the version „Dgl_Loeser_005.dpr".

We now want to discuss the extensions/addendum in detail as following:

The variables introduced in the lines 040a und 040b stand for the both capacitors, namely Q_1 and Q_2 for the electrical charge being stored there, and C_1 and C_2 for their capacities. The last mentioned (the capacities) are given to the algorithm in line 300a as real input-parameters (values to be entered by the user of the algorithm).

In line 281a, the circuit is activated with a short voltage pulse via U_{ext} , which begins at the time of 1% of the total duration of the complete analysis, and ends at the time of 2% of the total duration of the complete analysis. This method of activating the system, emulates the switches S_1 and S_2 (and their activation) in Fig.41, because only for a short amount of time, soon after the begin of the computation, a small amount of electrical energy is inserted into the system, which starts the operation of the ZPE-energy-converter.

Directly before the begin of the central core of the solution-loop in line number 347a, the counters for the electrical charge inside the capacitors ($Q_1 = \int I_{C1} \cdot dt$ and $Q_2 = \int I_{C2} \cdot dt$) are set to zero, in order to begin the integration with uncharged capacitors (for the sake of clearness of the results, the capacitors should not contain any initialising energy). The absolutely only energy, being inserted into the system from outside, is the impulse U_{ext} as mentioned above, which is necessary to start the operation of the system at all, and which is given short after the time-start of the numerical computations. The fact that the initialising voltage-pulse U_{ext} is not given already at t=0, but in reality a little bit later, has the very simple background, that the short time-interval from the very begin of the computation, until to the starting-process of the engine, that it shall be analysed (in order to ensure), that the computation-method really gives the result of "ZERO", as long as there is no stimulating energy within the system. This consistency-check has the purpose, to be sure, that the solver does not display and result different from "ZERO", only due to some numerical are computational errors (such as for instance numerical noise).

The computation of the electrical currents in the lines number 376a and 377a, goes back to the equation (59), but for the purpose of development of the algorithm, this equation has been reformed, so that we see the time-derivatives of the currents (these are $\dot{I}_1$ and $\dot{I}_2$) as written in (61). This has the purpose, that the notation fits to the $\partial I / \partial t$ as they are used within the solver inside the algorithm.

$$\frac{d}{dt} I_1 = \frac{1}{L_{11}} \cdot \left(U_{ext}(t) - R_1 \cdot I_1 - L_{12} \cdot \left(\frac{d}{dt} I_2 \right) - \frac{Q_1}{C_1} \right) \tag{61a}$$

$$\frac{d}{dt} I_2 = \frac{1}{L_{22}} \cdot \left(0 - R_2 \cdot I_2 + L_{21} \cdot \left(\frac{d}{dt} I_1 \right) - \frac{Q_2}{C_2} \right) \tag{61b}$$

The new summands in these equations (in comparison with (30), (36), (37)), representing the capacitors, are the summands of $-\frac{Q_1}{C_1}$ and $-\frac{Q_1}{C_1}$.

The integration-step from the electrical currents, up to the electrical charges inside the capacitors, is to be found in line number 381a, and this is in agreement with equation (57).

Last but now least, we regard the lines number 405a-d, where the charge conditions of the capacitors (electrical charge and voltage) are written to the Excel-protocol, and additionally to line number 424b, where the output of these data into the Excel-record-file is being done.

The application and some exemplary results of the algorithm, can be understood from the following graphics and explanations. Fig.42 shows the short initialising voltage-pulse, which activates the operation of the "SRMZT"-converter, of which the parameters are enumerated in the following example.

The data-set of the input-parameters for this example is here:

```
n1:=100; n2:=100;       {number of windings of the coils, primary (1) and secondary (2)}
Laen1:=1E-3; Rad1:=1E-2;  {length and radius of the coil number 1 (primary) in meters}
Laen2:=1E-3; Rad2:=1E-2;  {length and radius of the coil number 2 (secondary) in meters}
DD1:=5.0E-3; DD2:=5.0E-3; {thickness of the wire: diameter of the wire of the coils in meters}
A:=Sqr(4E-3);           {cross-section area of the yoke in square-metres = m²}
muo:=4*pi*1E-7;         {constant of nature, with the physical unit of  Vs/Am}
mur:=1.00;              {magnetic material-constant of the yoke, without physical unities}
Delay:=100;             {delay in yoke, number of time-steps "dt"}
R1:=0.02; R2:=0.02;           {Ohmic resistors, physical unities: Ohm}
tanf:=0; dt:=1E-8; tend:=0.1;   {time, time-steps and time-end in seconds}
rho:=1/(5.72E7);    {specific resistance of the copper in the wire of the coil, unit: Ohm*m²/m}
SchaukelSensibilitaet:=0.05;   {value with regard to the oscillation of the numerical-iterative solver}
Glaettungsstrecke:=1250;    {value with regard to retrospective smoothing, see above}
C1:=1E-1;  C2:=1E-1;     {capacities of the capacitors in the LC-oscillation-circuits, according to Fig.41}
```

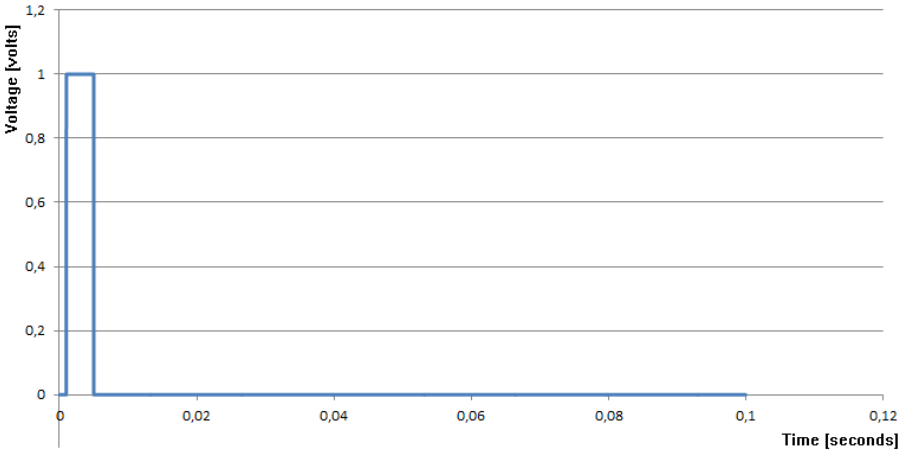


Fig.42

Exemplary voltage-pulse $U_{ext}(t)$ for the activation of the "SRMZT"-converter.

If we set the "Delay" in this data-set to ZERO and the parameter "Glättungsstrecke" to 50·dt, we will obtain currents in the coils as being plotted graphically in Fig.43. The values of the voltage in the capacitors, are plotted in Fig.44. The initialising voltage-pulse via U_{ext} begins at $t = 1\,ms$, charges up at first the primary circuit (curve in blue colour), but due to the (magnetic) coupling via the yoke, soon also the secondary circuit will be charged up electrically. Because of the attenuation due to Ohmic (total) resistances, both oscillations decay more or less quickly. And this is just what we expect, because we did this exemplary calculation with a "Delay" of ZERO (as stated few lines above), so that there can not be any conversion of ZPE-energy at all. The same behaviour can also be observed with the decay (attenuation) of the voltages of the capacitors (see Fig.44).

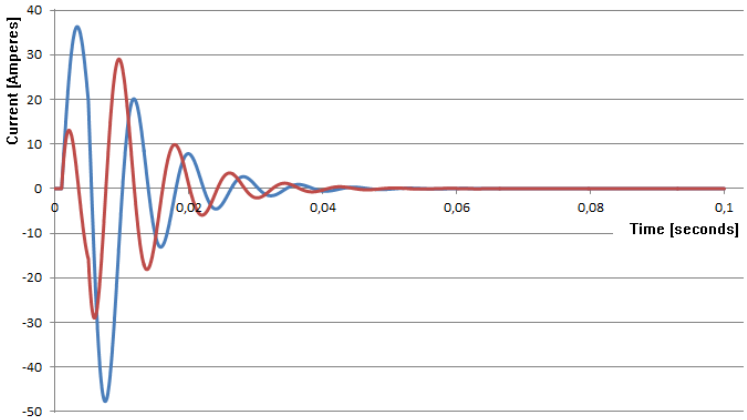


Fig.43

Electrical currents: in the primary coil (in blue colour) and in the secondary coil (in dark red colour).

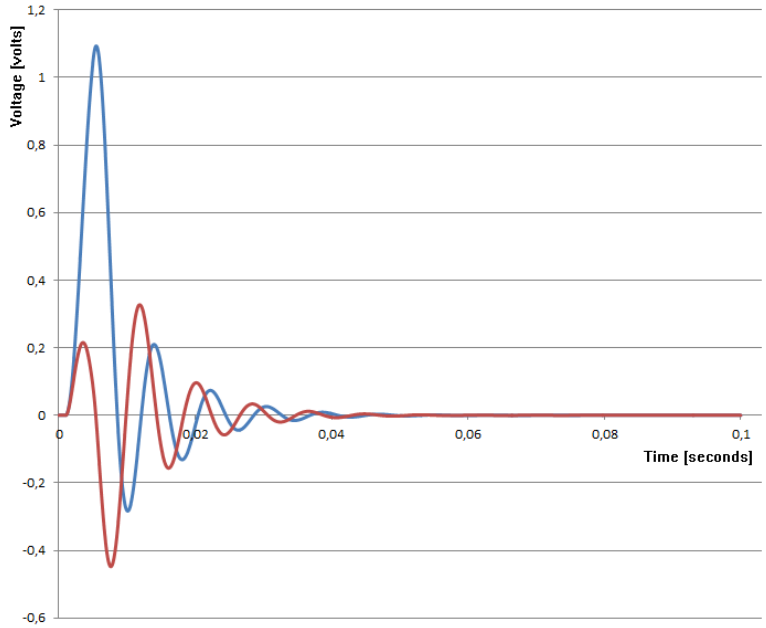


Fig.44

Voltage of the capacitors, for the primary capacitor in blue colour, and for the secondary capacitor in dark red colour.

Again (in analogy to section 6.4), the conversion of ZPE-energy is recognisable, when we watch the energy-balance, as we will see as following: The point is, that we can now enter a "Delay" different from ZERO into the algorithm, and with an increase of the "Delay", we directly observe an increase of the energy within the system, according to Tab.6. If we furthermore keep in mind, that the signal is faded down after approximately 40 ms, we estimate a converted power of

$$P = \frac{|E_{FPGW}|}{\Delta t} = \frac{5.614219 \cdot 10^{-5}\ J - 5.139448 \cdot 10^{-7}\ J}{0.04\text{s}} \approx 1.64 mW\ ,$$

without any optimisation of the system-parameters being yet done (giving many possibilities of optimisation and enhancing the power).

Delay (flux-retardation by the yoke)	$\lvert\Delta E + E_{FPGW}\rvert$ = computation-uncertainty plus conversion of ZPE-energy (absolute value)	At a "Glättungs-Strecke" of
0	$5.139448 \cdot 10^{-7}$ Joules	50·dt
10·dt = $20 \cdot 10^{-8}$ sec.	$6.200707 \cdot 10^{-6}$ Joules	50·dt
100·dt = $100 \cdot 10^{-8}$ sec.	$5.614219 \cdot 10^{-5}$ Joules	1250·dt

Table 6: Increase of energy in a "SRMZT"-converter-system according to Fig.41.
The parameter of "Glättungsstrecke" had to be chosen rather long (in time) at this example, because of the rather long Delays of 100·dt; and this was necessary in order to avoid a strong (disturbing) oscillation of the solver (of the differential-equation).

If we now chose the Ohmic resistances of the power-consumers extremely small, and if we furthermore use extremely thick copper-wire for the coils, in order to suppress the attenuation by power losses massively, we can observe an energy-gain rather easy, which builds up the energy inside the system. An example therefore is plotted in Fig.45, namely the currents through the coils, even if the assumed input-parameters are not yet realistic (and not yet optimised) for a practical realizable setup. The observation of the voltages of the capacitors, according to Fig.46 confirm this finding. Even if the parameters, which we presumed for the Figures 45 and 46 are not yet realistic, and even if the reaction of the system onto the (variation of the) values of the yoke-"Delay" is not yet clear but irregular, we definitely have the clear finding, that the "SRMZT"-system according to Fig.41, is a very efficient motionless ZPE-energy-converter, which can be operated as a self-running ZPE-engine, as soon as the dimensions of the parameters, are chosen in adequate way. Of course, we will have to adapt the parameters also to the practical necessities of the realisation (of a practical engine).

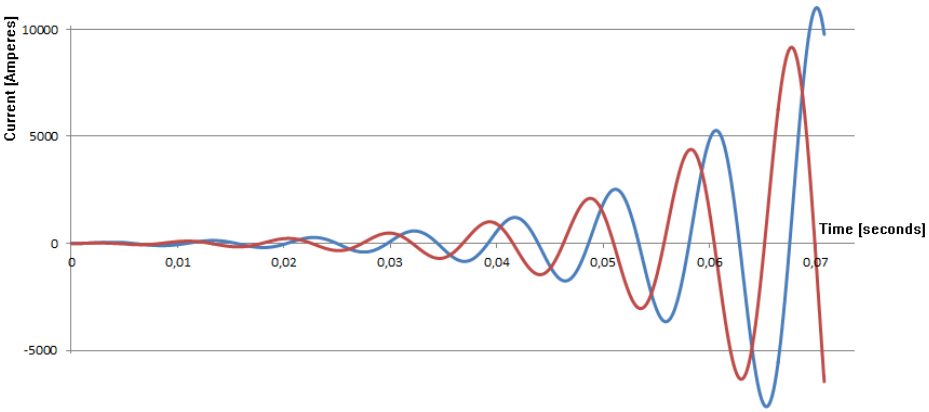


Fig.45
Electrical currents: in the primary coil (in blue colour) and in the secondary coil (in dark red colour) – here for an example with extremely low attenuation, as being achieved by strong reduction of all Ohmic loads.

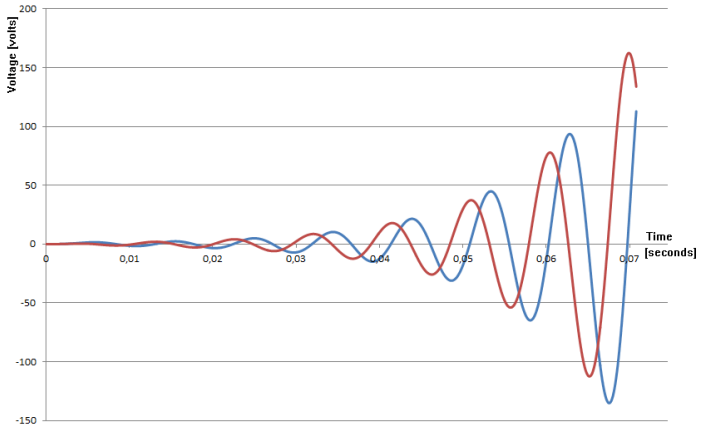


Fig.46
Voltage of the capacitors, for the primary capacitors in blue colour, and for the secondary capacitor in dark red colour – here for an example with extremely low attenuation, as being achieved by strong reduction of all Ohmic loads.

Because the implementation of concrete dimensions, as adaption to the practical realisation, is possible only after test-measurements (first of all with regard to the yoke-material and its delay-time), it is not possible already here, to describe actual parameters for a practical prototype. But what we can do, are further theoretical investigations, with regard to the computation-algorithm.

We want to begin this, with an analysis of the dependency of the amount of the converted ZPE-energy plus the computation-uncertainty $\Delta E + E_{FPGW}$ as a function of the Delay. The quality of the consideration depends on the length of time-steps of the iteration "dt"; a trail regarding this aspect can be seen in table 7.

There we set the parameters: Glättungsstrecke = 1250 · dt
Delay = 0·dt (ZERO)

Time-steps „dt"	ΔE = computation-uncertainity ($E_{FPGW} = 0$, because without Delay)
dt = $1 \cdot 10^{-8}$ sec.	$9.459938 \cdot 10^{-7}$ Joules
dt = $1 \cdot 10^{-9}$ sec.	$1.536107 \cdot 10^{-7}$ Joules
dt = $1 \cdot 10^{-10}$ sec.	$9.242833 \cdot 10^{-8}$ Joules

Tab.7: Test of the computation-uncertainty as a function of the fineness of the time-steps of the iteration.

The elapsed CPU-time of the computation-run with "dt = $1 \cdot 10^{-10}$ sec." is already not far below 2 hours, thus I did not try the computation with even more, finer and smaller time-steps. The suitability of this approach is also confirmed by the following investigation of the converted energy $\Delta E + E_{FPGW}$ as a function of the yoke-Delay, because we observe, that the computation-uncertainty is much smaller, than the amount of the converted energy, i.e. $\Delta E \ll E_{FPGW}$ (ΔE is smaller than 10^{-7}J, whereas E_{FPGW} is in the range of 10^{-6} … 10^{-5} J). This is doubtless a confirmation, that the amount of the computation-uncertainty is negligible small in comparison to the amount of converted ZPE-energy, in this example. If

we plot the amount of the converted ZPE-energy (after stimulation of the system, by one single voltage-pulse, as plotted in Fig.42) as a function of the yoke-"Delay", we receive Fig.47.

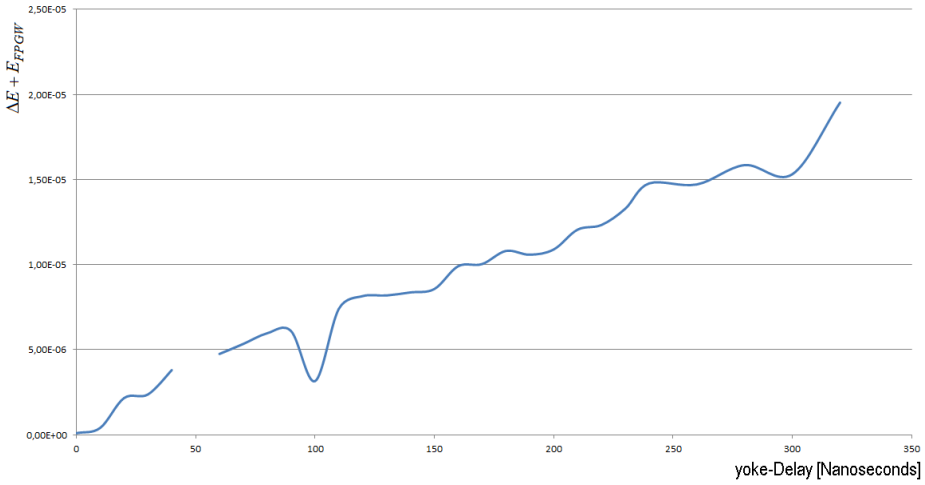


Fig.47
Exemplary computation of the converted ZPE-energy as a function of the yoke-"Delay".
(The discontinuity in the curve was made in order to exclude one "weird" value, which is far away from the curve. The reason for this problem is explained at the end of chapter 6.5.)

Besides a remarkable numerical noise (which would probably be less, if the time-steps would be smaller) (and: the datapoint at „Delay=50ns" is missing due the very strong numerical noise there), we recognise a clear behaviour, which states that the amount of converted ZPE-energy increases steadily with the Delay-time – and this observation absolutely confirms the validity of the algorithm (and the method) for the computation and simulation of (motionless) ZPE-energy converters. One of the reasons for the strong numerical noise, could probably have its origin in the decay of the attenuated oscillation of the charge carriers in both LC-oscillation-circuits, which are being coupled to each other, namely probably like this: Depending on the question, at which phase-position within the decaying oscillation, we finish our individual computation-run, we still have kept more or less energy within the system. But the phase-position at the end of the individual computation-run is not under control.

Consequence: In order to overcome the numerical noise, especially with regard to any later product-design-development of SRMZT-prototypes, the computation-run (for the determination of the converted ZPE-energy) can be repeated for several different time-Delay-values, and with the help of a regression-curve, it should be possible to determine the "best"-result for a the requested time-Delay-value. Let me illustrate this as following: If we would put the smooth regression-curve into Fig.47 (as for instance like a linear regression fit), there would be one rather clear value of $\Delta E + E_{FPGW}$ for every value of time-delay.

Furthermore from several test-computations, I learned (especially from the figures 45 and 46), that the amount of convertible ZPE-energy strongly depends on the Ohmic loads in both circuits (primary- circuit as well as secondary circuit). As reason therefore, I could find out that the amount of converted energy strongly depends on the question, whether the ZPE-converter works in the self-running operation-mode, or not. In order to get a clear answer to this question about the operation mode (self-running: "yes" or "no" ?), I want to define a criterion as described in the following lines.

Therefore we perform an investigation, at which we keep the Delay constant and alter the Ohmic load systematically. Because the numerical noise only plays an inferior roll, as we see also at the datapoint of "Delay = 2400 · dt = 240 ns" (see Fig.47), we want to alter the Ohmic load at this datapoint (with regard to the development of the said criterion). This means, that at this datapoint (for the fixed given time-delay of 2400 · dt), we want to alter the Ohmic load systematically, and to calculate $\Delta E + E_{FPGW}$ as a function of the Ohmic load.Table 8 displays the results (all of the results have been determined at a value of dt = 10^{-10} sec.).

Ohmic load: R1=R2 [Ohm]	E_{FPGW} (because ΔE is very small and can thus be neglected)
0.020 Ω	1.477159 ·10^{-5} Joules
0.019 Ω	1.613996 ·10^{-5} Joules
0.018 Ω	1.086033 ·10^{-5} Joules
0.017 Ω	- 4.360844 ·10^{-5} Joules
0.016 Ω	- 1.216237 ·10^{-4} Joules
0.015 Ω	2.081521 ·10^{-3} Joules
0.014 Ω	2.917095 ·10^{-2} Joules
0.013 Ω	7.067182 ·10^{-2} Joules
0.012 Ω	- 3.152147 ·10^{-1} Joules
0.011 Ω	- 4.010319 Joules
0.010 Ω	-12.81185 Joules
0.009 Ω	34.13147 Joules
0.008 Ω	423.1995 Joules

Tab.8: Amount of ZPE-energy being converted, as a function of the Ohmic load in the SRMZT.

Columns of numerical figures are confusing and difficult to comprehend – so why not plot the results of tables 5 graphically, for instance as data-pairs within a xy-coordinate-system ?

Answer: Because the values span a rather wide range, even in the order of magnitude. A logarithmic display could be used to illustrate such results, but this would be completely senseless under our circumstances, because there is no law of physics, which would justify a logarithm in the function of $E_{FPGW} = E_{FPGW}\left(R_1, R_2\right)$. Thus I chosed a different type of graphical illustration, which appears somehow funny on the first glance, but which is surprisingly instructive: Namely the plot of the two capacitor-voltages U_{C1} and U_{C2} against each other – see Fig.48. Fig.48 shows this type of plot for the example of R1=R2=0.020 Ω. The curves always begin in the origin of coordinates by principle, because at the very beginning (of each computation-run), the capacitors are unloaded, i.e. there is no capacitor-voltage. After inserting energy via the voltage-pulse U_{ext} (according to Fig.42), the capacitor-voltages begin to build up with oscillations, so their plot against each other has the shape of a spiral (depending on the phase-difference between both voltages). The capacitor-voltages increase, because they are supported with energy from the U_{ext}-pulse, which inserts energy slowly, via the coils. From the coils, the energy goes into the circuits, and thus also into the capacitors. And then the energy oscillates back and forth between the coils and capacitors (and the yoke) as being described above. After some time, the Ohmic losses extract energy from the circuits, and thus they attenuate the capacitor-voltages, the voltages of the coils, the currents in the coils, … (see Fig.49), so that all energy in the system is finally being consumed by the Ohmic resistances. Thus the capacitor-voltages finally come back to zero, i.e. to the origin of coordinates.

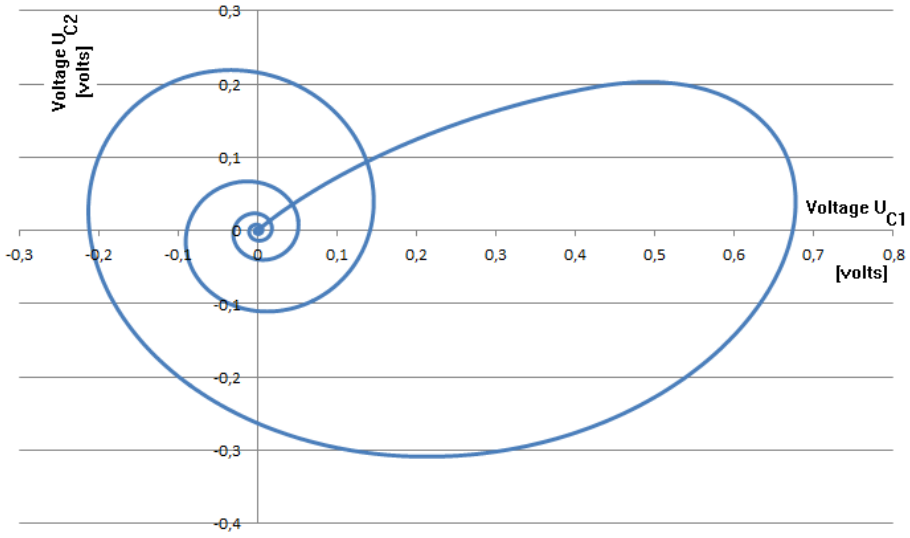


Fig.48

Plot of the capacitor-voltages in the primary circuit and in the second-ary circuit against each other.

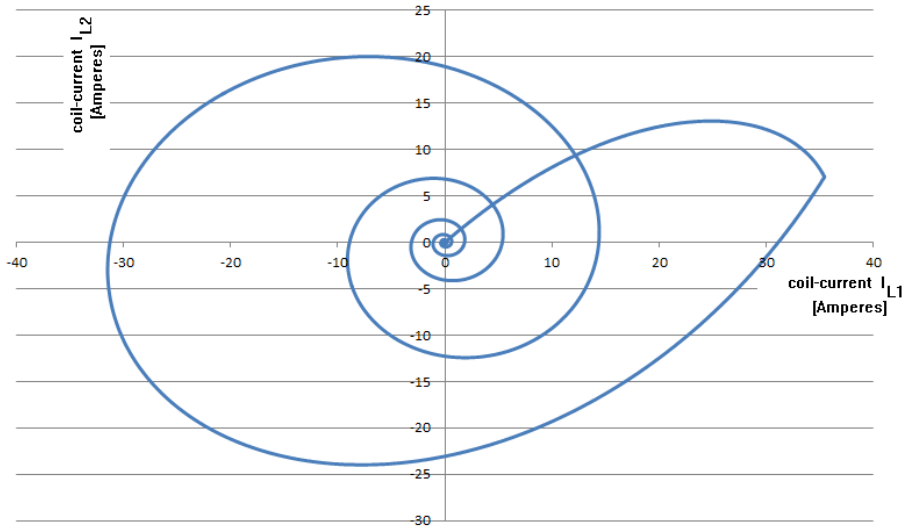


Fig.49

Plot of the currents in the coils in the primary circuit and in the secondary circuit against each other.

And the essential point is: The shape of these curves directly depends on the amount of power-extraction from the system, which is being emulated by the Ohmic resistors (losses). To comprehend this, we look to Fig.50, where we see a series of capacitor-voltage-plots U_{C1} against U_{C2} for different Ohmic loads. The explanation will follow after the graphs.

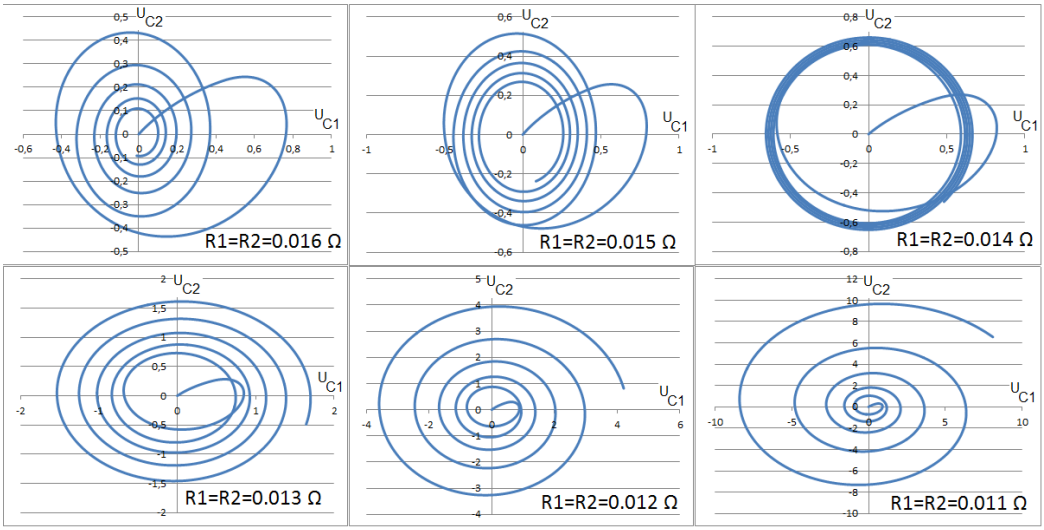


Fig.50

Capacitor-voltage-plots U_{C1} against U_{C2} for different Ohmic loads.

Axes of the coordinate system: Abscissa and ordinate both display "voltage" in the unit "volts".

Interpretation of the different plots of Fig.50:

Each round (around the origin of coordinates) represents one period of oscillation of the electrical charge in both circuits. The example of Fig.48 had been calculated with a rather high Ohmic load, so that even after very few periods of oscillation, the voltages and currents in the circuits had been attenuated down to zero. This is the reason, for which the curve goes back into the origin of coordinates rather quick. The computation-run, leading to Fig.48 had R1=R2=0.020 Ω. If we reduce the Ohmic loads (please see Fig.50: 0.016 Ω and 0.015 Ω), the number of periods, until the oscillation goes down to zero, increases visibly.

One prominent very special case, which forms the stationary operation of the SRMZT-converter, is achieved at Ohmic loads of about R1=R2=0.014 Ω: After initialisation (starting) of the system via one single external voltage-pulse U_{ext} , we leave the origin of coordinates, and after the transient phase, the operation-mode of the system runs into a closed cycle (around the origin of coordinates). As long as the voltage oscillations follow exactly a circular trajectory, the SRMZT-converter works in stationary operation mode, because the Ohmic loads extract exactly the same amount of power, as it is being gained by conversion from ZPE-energy. Thereby, the amplitudes of the oscillations neither increase nor decrease, on long time observation, but they keep constant. In the uppermost outer right diagram of Fig.50 (R1=R2=0.014 Ω), we see almost this behaviour, but not absolutely exactly (further explanations: see below). If the resolution of the graphic is enhanced, we see a spiral-shaped line, of which the distance to the origin of coordinates increases very slowly as a function of time. This means, that in

reality we could enhance the Ohmic load by a very small amount, in order to come to the stationary mode of operation.

The converted power in the stationary mode of operation, is to be calculated by dividing the energy of $2.917095 \cdot 10^{-2}$ Joules, (summed up over the time, during which this amount of energy was converted from the quantum-vacuum). BUT: We have to interpret this power as gain (from the ZPE-energy) within the LC-oscillation-transformer, and not as extractable consumer power, because it appears during the very first one or two periods of oscillation, and not later. This means, that the mentioned converted power described this way, is the power-gain during the transient phase of the system, during which energy is inserted into the system (from the quantum-vacuum), in order to bring the system into the stationary mode of operation.

Different from this energy-gain, the extractable consumer power is the power which is lost in the Ohmic-consumer-resistors (during time).

The very power which is converted from the ZPE-energy into the LC-oscillation-transformer during the start-up phase, and which has the purpose to bring the device into the stationary operation-mode, is being calculated from the energy gain (converted from the ZPE-energy) of $2.917095 \cdot 10^{-2}$ Joules and the duration of oscillation of the start-up period (in time), during which this energy-gain was brought into the LC-oscillation-transformer. This oscillation-duration can be found from the evaluation of the results, to be approximately 88.7 ms (see Fig.51), so that the power during this start-up phase is a little bit less than ¼ Watt according to equation (62).

$$P = \frac{E_{FPGW}}{T} = \frac{2.917095 \cdot 10^{-2}\mathrm{J}}{88.7 \cdot 10^{-3}\mathrm{s}} = 245 mW \qquad (62)$$

When the Ohmic load is further reduced (as plotted in the second line of the series of Fig.50, these are the examples with R1=R2=0.013Ω / 0.012Ω / 0.011Ω), the power consumption in the Ohmic loads will become too small, to consume the complete amount of ZPE-energy being converted per time from the ZPE-energy of the quantum-vacuum (i.e., this is the converted power). The consequence is, that the oscillation permanently grows in amplitude. In this case, the power being converted from ZPE-energy is not any further completely extracted from the system, but it remains (partwise) inside the SRMZT-converter. With the increasing power and energy inside the converter, also the amplitudes of the capacitor-voltages (and same of the coil-currents) increase, so that the spirale of the voltage-plots does not go back to the origin of coordinates in the end of the computation, but the spirale remains open to the outside. (Under such operation, the energy within the SRMZT-converter can increase, until finally the system would be destroyed.) This also explains the reason for the strong oscillation back and forth, in the energy balance of table 8: Because the end of the time-interval of the computation, is not adjusted to the duration of the oscillation of the SRMZT-converter, the voltage-amplitudes are to be found at some arbitrary phase-positions within the oscillations, and the energy which is present at this arbitrary moment (at the end of the computation-run), is then interpreted as the energy-gain in table 8. Even the algebraic sign of this energy-gain depends on the arbitrary phase position within the period of oscillation. It is only a question of the phase-position, at which the computation stops.

For the development of a practical design of a SRMZT-converter, this means:

We have to construct the engine in such a way, that it runs into the stationary operation mode for long-term operation, and this has to be achieved by appropriate adjustment of the loads. The loads have to be adapted precisely to all the other parameters of the SRMZT-system. An exemplary demonstration of the converted power will follow after Fig.52, for this very operation-mode, which can be driven permanently/endlessly with the system of the system-parameter of our very computation-example.

If the dimension (especially the size and the power) of the engine shall be altered, not only the dimensions of the components of the setup have to be changed, but also the Ohmic (and other) loads have to be adjusted in such manner, that the engine will run into the stationary mode of operation, which can operate endlessly stable. In praxis it can (of course) not be expected, that we can get electronic components, which are adjusted to the endless mode of operation so exact, that the engine

can operate over months and years, without drifting away at all. Consequently it is clear, that we need some (probably) electronic regulation, which permanently adapts the load (and thus the extracted power) to the requirements of the operation mode, so that short-term deviations from the stationary operation-mode are compensated always (soon, as immediately as sensibly possible), so that the capacitor-voltages (as well as the coil-currents) are prevented from drifting away.

Examples for slowly decreasing and for slowly increasing capacitor-voltages, are presented in Fig.51. These graphs are plotted in order to demonstrate, how the operation of the SRMZT-converter looks below and beyond the stationary mode of operation. The electronic-circuitry for the regulation and control of the operation mode (which will have to be developed for a practical setup laboratory, as well as for series-engines) must be orientated along such curves, in order to fulfil the task, to drive back the converter to the stationary operation, as soon as it drifts away more than allowed, in order to keep the engine in the self-running operation-mode. By this means, the regulated SRMZT-converter will always do some (more or less small) pendulum movement around its working point, which is defined as the stable operation-mode. The electronically controlled load must be developed in such a way, that it will lead to an (irregular) oscillation around the exact circle of the stationary operation-mode, if its behaviour is being plotted, in the manner of Fig.50.

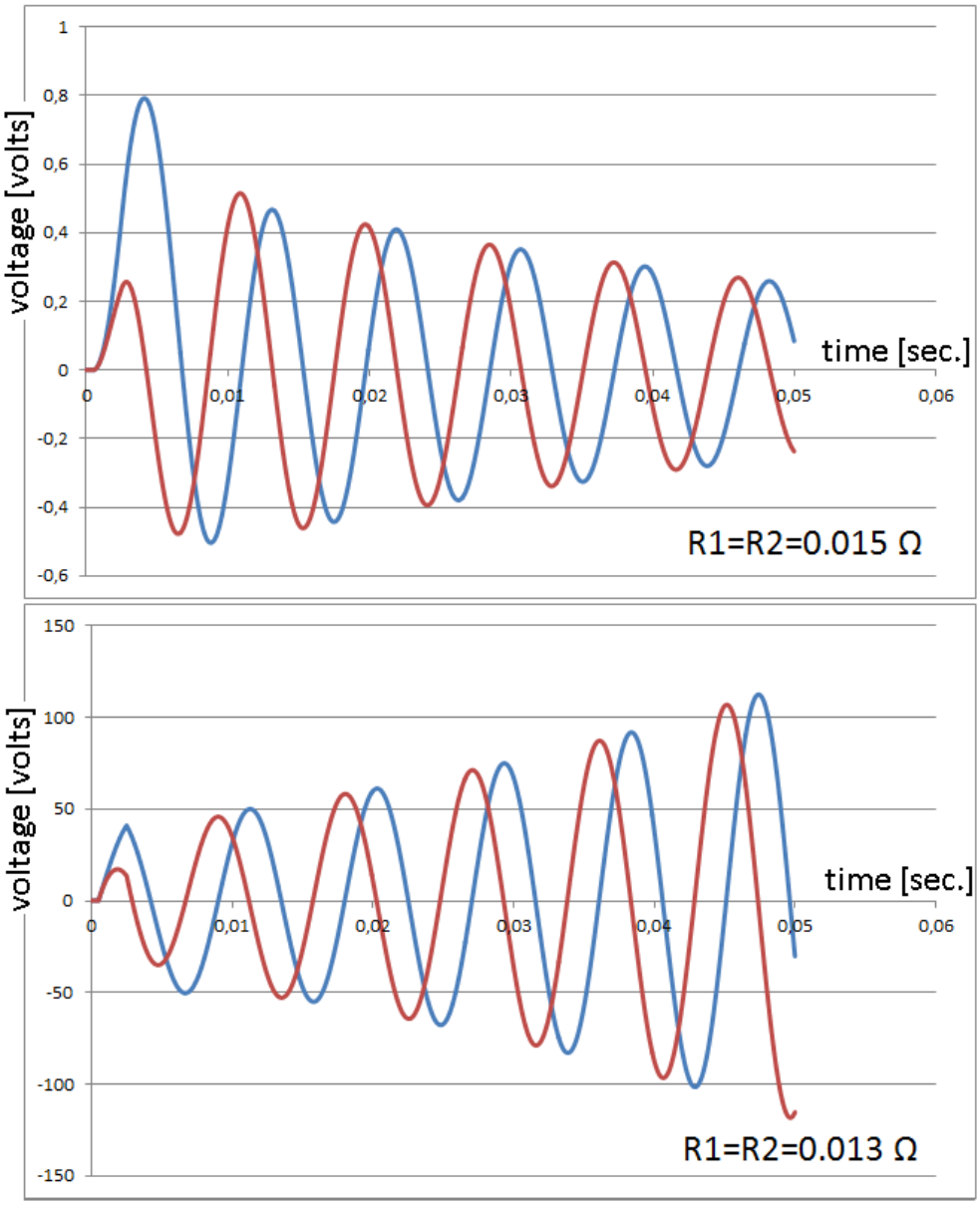


Fig.51

When the SRMZT-converter drifts away from the stationary operation-mode, the amplitudes of the capacitor-voltages do not remain constant during time (U_{C1} in blue and U_{C2} in dark red colour).

The correspondence with the accordingly figures in 50 is obvious.

Whereas the capacitor-voltages in Fig.51 give a clear evidence for an increase of the energy within the system (at the first plot in 51) respectively for a decrease of the energy within the system (at the second plot in 51), the extraction of energy (and power) via the Ohmic load is something totally different. The energy computations according to table 8, as being discussed up to now, refer the energy-increase within the system, but the extraction of energy (and power) via the loads, is being regarded in the equations (47b) and (47c), which is the namely power, which is consumed permanently by the Ohmic resistors. In the Excel-datarecord-files, these power-values are written into the columns “I“ and “J“. By the way, it should be mentioned, that the loads can be Ohmic loads, but different types of loads are also possible, as long as the loads (and its energy-extraction) allow a stable stationary operation mode of the SRMZT-converter.

A graphical plot of the extracted power from the Excel-columns “I“ and “J“ (see Fig.52) demonstrates the benefit of the system, which is the power being given from the SRMZT-converter to the consumer.

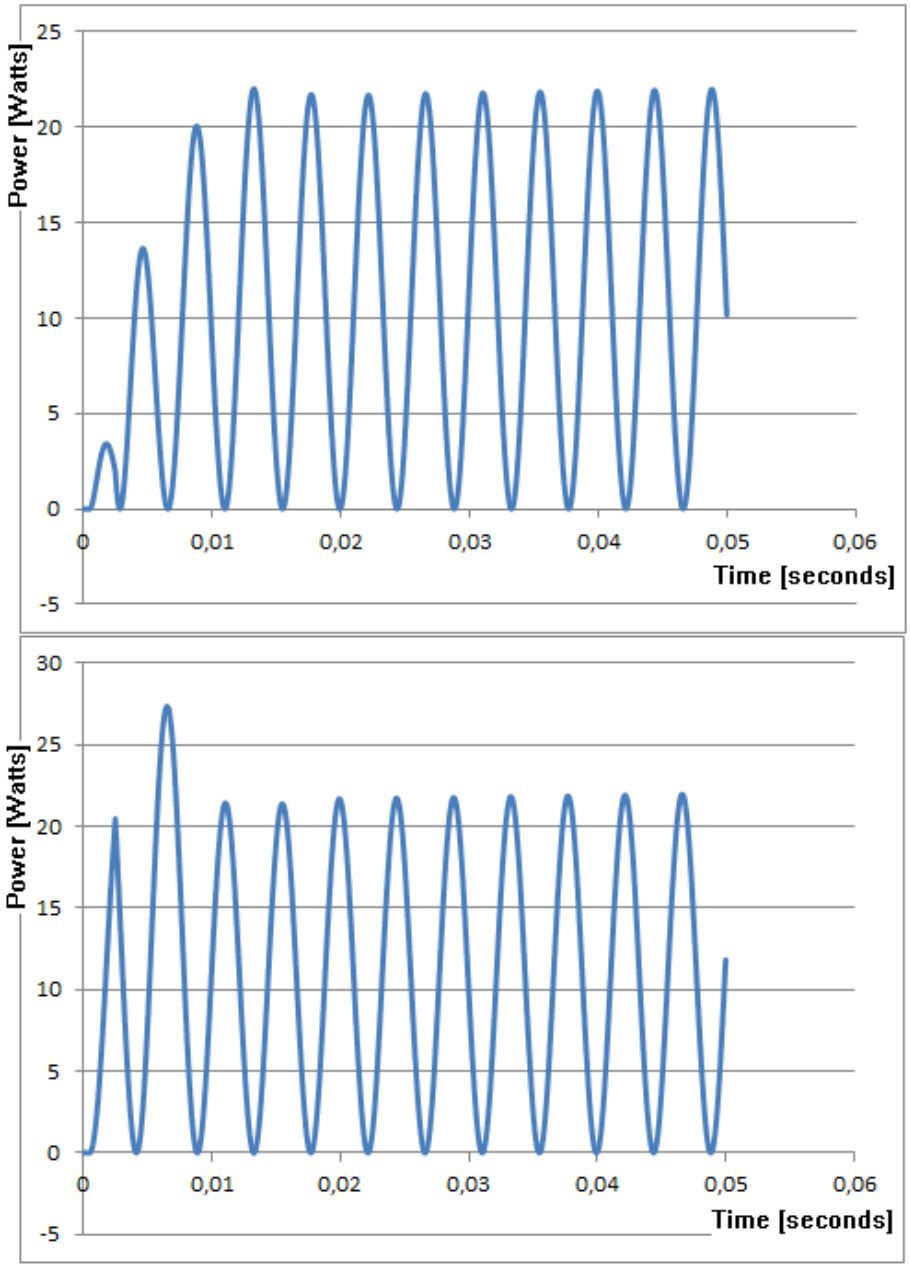


Fig.52

Extracted power via Ohmic loads by pure Ohmic resistors, where the Ohmic losses in the coils, are not being regarded as extracted power.

The first graphic displays the power-extraction by the load-resistor in the secondary circuit.

The second graphic displays the power-extraction by the load-resistor in the primary circuit.

Because the currents (after the transient phase) follow a sinus-shape, the extracted power follows a sinus-square-shape, as a function of time.

In order to come into the stationary operation-mode, the load resistor had to be adjusted to a value of (14.13 ± 0.01) mΩ in the regarded example.

During the transient phase, which needs approx. 2…3 periods of oscillation, we see, that the currents adjust themselves to their permanent values for the stationary mode of operation. In the primary circuit (see bottom part of Fig.52), the starting-pulse of U_{ext} at first inserts more energy into the system, then what would be necessary for the stationary operation-mode (we see the overshooting amplitude of the

second period), but this energy-spillover is distributed via the yoke into the secondary circuit, so that from the fourth period on, the secondary circuit reaches the amplitude, which is necessary for the stationary operation; and the primary circuit already has reached this stable operation mode at the third period.

Because the energy-input via $U_{ext}(t)$ does not persist during the complete transient phase (but the energy-input does only occur during the very first begin of the transient phase), even some of the energy necessary for the transient phase is taken from the ZPE-energy-reservoir. It is this very energy, which is (as stated above) given as $2.917095 \cdot 10^{-2}$ Joules in table 8. Because the SRMZT-converter is not yet under full operation during the transient phase, the Ohmic loads do not yet extract their full power, as they do during the stationary operation-mode. This allows the system, to use some of the converted ZPE-energy during the transient phase, for bringing the converter to the stationary operation-mode.

The maintenance of the stationary operation-mode, reacts extremely sensitive on the value of the consumer load-resistance. From the example of $R_{V1}=R_{V2}=(14.13 \pm 0.01)$ mΩ, on which Fig.52 was calculated, we derive an extracted power on the consumer resistances of $P_{V1} = (21.8 \pm 0.2)$ Watts and $P_{V2} = (21.7 \pm 0.3)$ Watts. The uncertainty-intervals refer to the computation-uncertainty of the iteration and to the numerical noise of the solver of the differential-equation.

Due to the rules of electrical engineering, the effective power of sinus-shaped alternating-voltages and alternating-currents (and thus sinus-square-shaped alternating-power), has half of the value of the power-amplitude, we have a mean average value (over time) of the effective power (in the stationary operation-mode) in the height of $½ \cdot (21.8 \pm 0.2)$ Watts in the primary circuit and $½ \cdot (21.7 \pm 0.3)$ Watts in the secondary circuit. This means, that the sum of the half of both values, gives the total power output of the SRMZT-converter, in the computation example, this is (21.75 ± 0.3) Watts.

The SRMZT-converter, as being presented here, thus brings permanently a useful power output of somewhat more than 20 Watts.

In consideration of the size of the setup – the yoke consists of a torus-ring with a diameter of 10 cm – this is indeed a sensible value, especially if we keep in mind, that an optimisation of the system-parameters is still yet completely open (and can be performed as soon as measurement results regarding the delay-time of the yoke-material will be available).

Practical remark:

The power capability of the SRMZT-converter, is determined by the yoke, by the coils and by the capacitors. The Ohmic load-resistors regulate the operation-mode of the SRMZT-converter. These load-resistors must be adjusted to the requirements of the yoke, of the coils and of the capacities extremely exact, in order to enable the system to work in a permanent stable stationary mode of operation. Due to practical reasons, it will be utterly impossible, to buy two Ohmic load-resistors, which follow the requirements of the setup exactly, with a precision of „X“ significant numerical decimal digits. Thus it will be necessary, to develop a special consumer with a continuously controllable value of the Ohmic resistance. This will have to be realised by a special electronic circuitry.

Furthermore it is not the aim, to build a setup, containing two extremely exact Ohmic load-resistors, only for the purpose to prove the functional capability of one SRMZT-prototype, but in reality is the aim, to supply power (converted from the quantum-vacuum) permanently to the consumer. And it can be for sure excluded, that every consumer will always respect the requirements of the stationary operation-mode (of his individual engine) during a long-term operation, with a precision of four, five or more significant numerical decimal digits, regarding the load-resistance. Consequently, we must have some facility, buffering the energy being converted from the quantum-vacuum, and some regulation, which permanently adapts the load (as a function of time) to the individual requirements of the SRMZT. We could for instance think about a strong accumulator as buffer, such an accumulator as they are used in the automotive industry as starter-batteries. The charging rate of such an accumulator can be controlled via the voltage, and this would be one possible idea to regulate the load of the SRMZT.

The permanent adjustment and regulation of the values of the load-resistance will have to be performed by an electronic circuitry, which will have to be developed especially for this purpose. If the load-resistance is too large, it suppresses the operation of the SRMZT, and the engine stops to work after some time. If the load-resistance is too small, there is too many energy remaining inside the SRMZT, so that the oscillation (of the currents and of the voltages) will become too strong, so that after some time the system will become hot; and if the oscillation is not reduced early enough, there is even the risk that the system might burn down, which can be avoided by an enhancement of the load-resistor, which regulates down the extracted power and the energy inside the system. Enhancing the load-resistor has the consequence, that at the very first moment, the extracted power will be increased, and soon there will be less power in the system, so that the operation mode will calm down.

Fortunately, the regulation of the load allows a rather wide hysteresis, so that development of the electronic circuitry for the regulation and control will not face unsolvable problems. The limits of this regulation-hysteresis are fortunately given as following:

1. Down to small electrical current-values, the transient mode during the very first periods of oscillation in Fig.N21 teached us, that the system does not switch off very quickly, if the energy inside the circuits does not go down below the special value, which is necessary for the stationary operation. From the theoretical investigations behind Fig.52, we learned that the system recovers by alone, going back to the stationary operation mode, being supported with energy from the quantum-vacuum.
2. Up to large electrical current-values, the operation will become critically only, when the energy within the system becomes so much, that the system overheats. It should not be a complicated technical challenge, to supervise the condition, that the operation of the system will be reduced, as soon as the temperature exceeds a given well-defined limit. In reality it should even not be a problem to take care, that the temperature does not come too close to such a limit.

For the practical realisation of an adequate regulation, we can imagine for example a scenario according to Fig.53. Therefore we also have to respect the fact, that the **real** self-running engine must take the energy for its own requirements from its own production. In our case, the own requirements describe the energy being necessary for the operation of the electronic circuitry of the load-regulation, and the energy which is necessary to initialise the starting-impulse of U_{ext} .

The buffers are necessary, because the SRMZT always produces energy according to its own requirements, and the consumer always takes energy according to his own requirements.

The request to supply the energy of the own requirements from its own SRMZT-production, has the consequence, that the energy being extracted from the consumer-resistances R_{V1} and R_{V2} can be delivered to the consumer not completely, but only partwise, and that some other part of the energy being converted from the quantum-vacuum, must be given back to the converter for its own requirements. As mentioned above, this might be realisable, if we represent both loads of R_{V1} and R_{V2} by electronic circuitries, which have the task to supply the converted energy from the quantum-vacuum to the accumulators (see Fig.53). These are the buffer-accumulators, and they can provide the necessary energy for an external user, as well as the energy for the own requirements and for U_{ext}.

If the buffer accumulators are economically priced and robust automotive accumulators (which have a fatigue life of about 8…10 years), the buffer can be charged up with energy during 24 hours per day; and if the user only needs energy for a few hours per day, the power capability of the system is sufficient, as soon as the SRMZT is able to produce the average mean value of the power, which is needed over the day. If we for instance estimate the little example of a SRMZT-transfomer producing a power-output of 25 Watts, we get 0.6 kWh per each day. This would be enough to charge up an automotive accumulator of 12 V and 50 Ah during one day (completely from the energy of the quantum-vacuum) (we do not care about the COP of the accumulator now, but this is not important in the moment). Let us assume arbitrarily (just to give us the possibility to estimate an example), that the circuitries for the regulation of the electronical R_{V1}- and R_{V2}- representatives consume permanently 4-5 Watts, and the that U_{ext}-

starting-pulse has negligible small consumption (because it is necessary only once, when the SRMZT-transformer is started from the standstill), we need perhaps 100 Wh for the own requirements of the SRMZT-converter per each day. This means, that we can give the remaining 0.5 kWh from the auto-battery to the user. And the user can have this amount of energy just as she or he likes. She or he has the free choice, to have very large power doing a short time, or to have moderate power during longer periods of time.

Clear is of course also, that the SRMZT-transformer-converter can be scaled up and scaled down in size arbitrarily, in order to be convenient for every type of user. (Scaling up is easier than scaling down, because the larger the yoke, the larger the delay-time, the more efficient the power-conversion from the quantum-vacuum.) And if we have extremely large users in mind, such as for instance industrial clients, it is of course not necessary, to provide accumulators strong enough to store (to buffer) the energy for a complete day of operation, but is also possible to give some of the converted energy directly to the user, without buffering all the energy she (or he) needs.

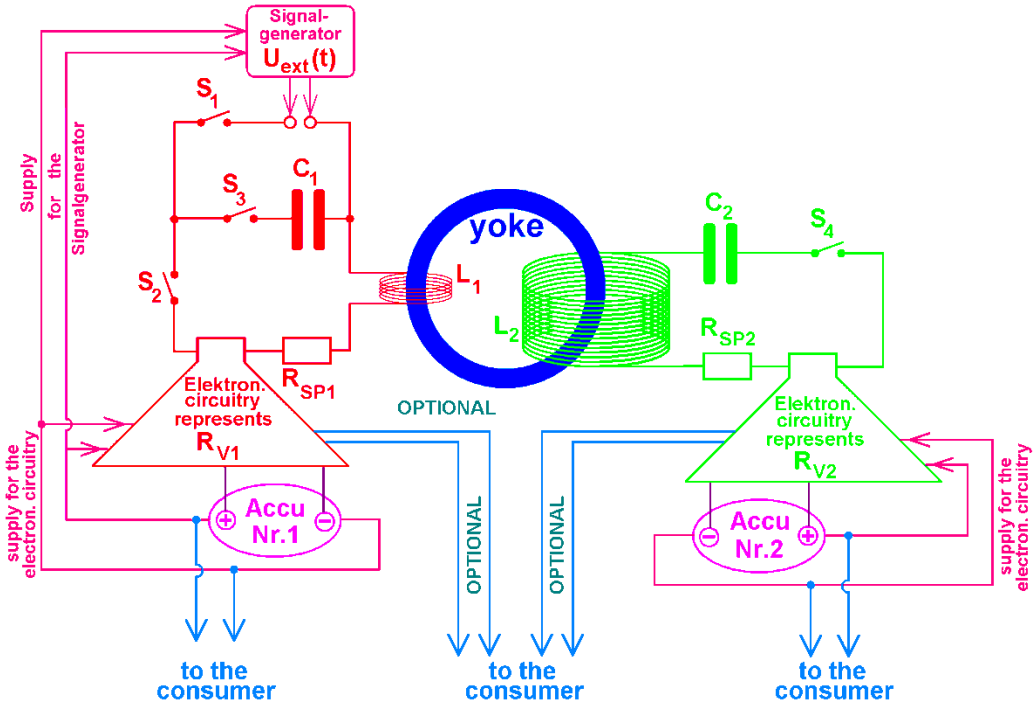


Fig.53

Embedding of a SRMZT-transformer- ZPE-converter into the setup of a real self-running engine, which produces the energy not only for the users, but also for complete own require-ments of the SRMZT-system.

I want to close up my paper with a short expression of my personal opinion:

According to my believe, a zero-point-energy converter is only operable satisfactory, if it can be presented as a real self-running engine. Mere over-unity engines do not fulfil this requirement satisfactory, and I insist in this demand of the "operation as real self-running engine", in order to exclude for sure the widespread risk, of measuring errors and self-delusion, which many inventors have, when they evaluate their zero-point-energy converters. In the last years, I was visited by many freelancing inventors, who presented me there supposed over-unity engines. None of them was able to withstand a serious analysis by substantiated measurements. Not one single setup which was brought into my laboratory (and there have been several very different constructions, working according to very different principles), was able to display a coefficient of performance of 100% or more; all of them had COP-values below 100%. This experience, grown during several years, fully convinced me, to accept zero-point-energy converters only, if they are **real** self-running engines. „Over-unity" is not enough, because the risk for measuring-errors is too large. Only if the system does not require any classical energy-input at all (for an endlessly running engine, a single initialising starting-pulse is of course no problem), and if it is able to supply its own energy-requirements from its own production, and furthermore if it runs endlessly

(without systematic restriction of operation-time), the system is beyond all doubts. And only in this case, I will accept it as a zero-point-energy converter.

On this background, I regard my theoretical investigations about the topic **"motionless zero-point-energy converter"** (see section 6), as having a result only, after the real self-running setup (SRMZT) was presented in section 6.5.

The same background, the necessity to have a real self-running engine, is also the reason why I decided to develop the "MMDR" as a magnetic zero-point-energy converter.

Only real self-running ZPE-converters are to be taken serious, because they do not need any energy-input, and thus there is no danger to measure any artefact instead of an "over-unity".

At this point, my theoretical investigations regarding the development and construction-principles of zero-point-energy converters, and regarding the fundamental theory of ZPE-conversion as well as the fundamental construction-basics, came to a result, which now arises the request for practical realisation on the basis of solidly laboratory analysis and experimental investigations. As far as it is possible on the basis of theory, without having access to any scientific laboratory, I worked out my theory, and I presented my results, beginning from the high-speed magnetic motor, including several other systems, and finally coming to a motionless converter. From now on, experimental laboratory work is indispensable.

The basic fundament of ZPE-energy conversion is the FPSIF-principle, and with the preceding paper, I demonstrated, that it is possible to develop several ZPE-converters on its basis. The FPSIF-principle, this is the principle of the "**F**inite **P**ropagation-**S**peed of the **I**nteracting **F**ields", which is to be understood as the theoretical fundament of ZPE-energy conversion. It originates from the knowledge of the retarded potentials according to Liénard and Wiechert, which can be found in many standard textbooks of physics.

In the year of 2011, I presented a possible example of a ZPE-energy converter, functioning according to the FPSIF-principle, under the name of "**E**lectro-**M**echanic **D**ouble-**R**esonance converter" (EMDR). But in this example, there have been several ambiguities and even some computation-errors. They are not a principle problem for the system, but: Although the EMDR-principle can work, the numerical values I wrote in my publications in 2011 do not describe an operable system. A functioning EMDR-system must have different numerical values for the dimensioning of the construction. With the present publication here, all former ambiguities are cancelled, and all former computation-errors (from 2011) are corrected. The next scientific step can and must now be, to build up practical prototypes of those ZPE-converters, which are theoretically developed in the present paper. Unfortunately, I cannot start to work on this task, because I have no budget, no co-workers, no equipment, no measuring-devices, no time, no manufacturing- possibilities, nothing . . . .

7. Resumée and Future perspectives

The conception of the **F**inite **P**ropagation-**S**peed of the **I**nteracting **F**ields (FPSIF), going back to the retarded potentials of Liénard and Wiechert, is to be regarded as a possible basic fundament of the conversion and utilization of the zero-point-energy of the quantum-vacuum. The ZPE-energy converters, presented in the preceding paper, have been developed on its basis.

The sections 1-4 (and appendix 8.1) now close all logical gaps which had existed in former EMDR-publications. Without any logical gaps, a magnetic motor as ZPE-energy converter is being developed, taking the finite propagation speed of the magnetic field fully into account. Although it would not be a problem, to apply the theoretical principle of the FPSIF-theory also explicitly to formally presented EMDR-converters, I decided to present a newly developed different system, namely pure magnetic ZPE-motor (without any oscillation circuit) in sections 1-4, because this is easier for the technical manufacturing of a prototype, as well as for the theoretical simulation on the computer. Thus it has advantages to work with a new system here. This is the device, which I called the "MMDR"-converter.

The results of these considerations is a ZPE-energy converter, with realistic producible dimensions, of which smaller units (as for instance with a rotor-diameter of 1 meter) are indeed appropriate for the manufacturing of prototypes, for the purpose of testing and of presentation. Moderately larger units (as for instance with a rotor-diameter of 2 meters) appear sufficient for the technical power-supply of houses, and if the size of the devices is enhanced further on, also large-scale industrial consumers can be supplied with energy. By principle, every energy consumer can use the energy from ZPE-energy converters, also cars and all mobile users.

Because now all open questions of the FPSIF-theory are answered, the results encourage, to begin with the practical realisation of a ZPE-magnetic-motor – namely with the type of the MMDR-converter. But also technical refined advanced developments, such as for instance the EEDR-principle should not be forgotten.

In order to stimulate several technical optimisations (and to point out improved concepts for new engines), section 5 has been attended, containing a practical collection of ideas (see sections 5.1-5.4) and an expansion of the theory (see section 5.5), also with regard to different systems (known from literature).

Furthermore, section 5.3 contains some economic considerations, which demonstrate how low in price electrical energy can be supplied, without large effort. The crystal-cells as described in section 5.3 are capable to deliver electrical energy with a price below 1 cent/kWh, the MMDR-converter (same as the SRMZT of section 6) can deliver electrical energy even below 0.1 cent/kWh.

In order to minimise technical wear during the years, and in order to enhance the fatigue life of the engines, it can be an ideal solution, to leave away construction elements in motion, as far as possible. ZPE-energy converters which follow this percept perfectly, because they do not have any construction elements in motion at all, are known under the name of a "motionless-converters". Such devices allow only fields (as for instance magnetic fields, electric fields, …) to be in motion, and elementary particles, such as for instance electrons in wires, coils, capacitors, … (i.e. electrical currents). But there is nothing in motion besides fields and the electrons.

An overview over possible ZPE-energy converters is only complete, if it includes (minimum) one motionless-system. Such a system was developed in theory (in section 6) under the name of "**S**elf-**R**unning **M**otionless **Z**PE-**T**ransformer" (SRMZT). An exemplary algorithm for the computation of such a systems is presented in the appendix 8.2, which has the purpose to help everybody who reads it, to come into the situation, to develop her of his own motionless-ZPE-converter. The output-power of approximately 20-25 Watts, as it is expected (theoretically) in the presented example with a transformer torus-ring of diameter of 10 cm, has a sensible order of magnitude, and furthermore it offers extensive possibilities for optimisation.

It is a matter of fact, that all energy sources introduced in present paper (tapping the zero-point-energy of the quantum-vacuum) are absolutely friendly to the environment, to our earth, and to the health of humans, animals, plants and everything. It is also a matter of fact, that the energy from the quantum-vacuum is accessible everywhere, for everybody, unlimited, technically reliable, at all time permanently and constantly, and of course free without any restrictions, and last but not least without any payment. Energy-costs only describe the price to buy or build the converter, the engine which is necessary to convert the ZPE-energy.

8. Literature-References

Because the present article is in main parts an expansion, upgrading and completion of former work of the author, the list of literature-references contains (different from other literature lists of the same author) rather many references to his own former work, on which the present article is built up.

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9. Appendicés: Source-Codes of several algorithms [Bor 99]

9.1 Source-Code of the algorithms (MMDR_03i) [Bor 99]

```
001 Program MMDR_03i;
002
003 { ********************************************* }
004 {      Copyright by   Prof. Dr. C. Turtur      }
005 {                     Wolfenbüttel             }
006 { ********************************************* }
007
008 {$APPTYPE CONSOLE}
009 {$N+}
010
011 uses
012   Windows, Messages, SysUtils, Classes, Graphics, Controls, Forms, Dialogs;
013
014 Const AnzPmax=10000000; {Dimensions of the Arrays for the data-export to Excel}
015
016 Var epo,muo,c       : Double;  {Constants of nature}
017     L               : Double;  {Length of the magnets}
018     ZW              : Double;  {intermediate spaces between the magnets in the rotor}
019     AnzMag          : Integer; {number of magnets per each disc or rotor}
020     m               : Double;  {inertial mass of the magnets, if applicable including the rotating disc}
021     Spaltenzahl,Spaltenlaenge   : LongInt; {Size of the Excel-Output}
022     Erg             : Array [1..25,0..10000] of Real; {Results for Excel}
023     Kieh            : Char;    {Is a data required required ?}
024     Versionsname    : String;  {For the automatic numbering-procedure of the Excel-result-Files}
025     I,J             : LongInt; {counter-variable for the trajectory}
026     delT            : Double;  {duration of each single time-step}
027     X,V,A,T         : Array [-1..AnzPmax] of Double; {Storage of the trajectories, position, velocity, acceleration and the time-steps}
028     dE,E            : Array [-1..AnzPmax] of Double; {energy alteration at each single step of the trajectory, two types of calculation}
029     Aca,Vca,Xca     : Double;  {approximation for acceleration/velocity/position to be remarked for the purpose of comparison}
030     Xanf,Vanf,Aanf  : Double;  {initial values for position, velocity, acceleration}
031     XWW,TWW         : Array [-1..AnzPmax] of Double; {Storage of the trajectories, position, velocity, acceleration and the time-steps}
032     Fmax            : Double;  {maximum of the force – holding force of the magnets}
033     PolMax          : Double;  {Maximum (in the polynomial)}
034     SZ              : LongInt; {number of steps for the resolution in time-steps}
035     Xecht,Techt     : Double;  {Starting-position and starting-time of the field of interaction}
036     Tfeld,Tpartner  : Double;  {runtime of the field and of the partners of interaction}
037     IterFak         : Double;  {factor for iteration}
038     tut1,tut2       : Boolean; {Control of the iteration}
039     Tgl,Tgm,Tgr,Xgl,Xgm,Xgr          : Double;  {Interval of time and position for the Interpolation of the trajectory}
040     TlaufFeldL,TlaufFeldR,TlaufFeldM : Double;  {real values of runtime (of the field)}
041     TlaufPartL,TlaufPartR,TlaufPartM : Double;  { real values of runtime (of the interacting partners)}
042     DU,R,DR,Umf,om   : Double; {diameter, radius, rounds per minute, circumference, angular velocity of a real magnet-rotor to be manufactured}
043
044 Procedure Wait;
045 Var Ki : Char;
046 begin
047   Write('<W>'); Read(Ki); Write(Ki);
048   If Ki='e' then Halt;
049 end;
050
051 Procedure Zaehlnummer_lesen;
052 Var  fin   : Text;    {File containing the counter-number of the Excel-results-version}
053       NR   : Integer; {counter-number for the next Excel-File}
054 begin
055   Assign(fin,'Zaehlnummer.dat'); Reset(fin); {open File now}
056   Readln(fin,NR); NR:=NR+1;
057   Close(fin); {close File now}
058   {in the file containing the counter-numbers, the counter-numbers has to be increased:}
059   Assign(fin,'Zaehlnummer.dat'); Rewrite(fin); {open File now}
```

```
060   Writeln(fin,NR);
061   Close(fin); {close File now}
062   {In the following lines, I have to construct the file-name:}
063   Str(NR,Versionsname);
064   Repeat
065     If Length(Versionsname)<5 then Versionsname:='0'+Versionsname;
066   Until Length(Versionsname)=5;
067   Versionsname:='Versuch_'+Versionsname+'.xls';
068   Writeln;
069   Writeln(Storage of the computation in the Excel-File: ',Versionsname);
070 end;
071

072 Procedure ExcelAusgabe(Name:String);
073 Var fout        : Text;    {time-scale and up to 25 data-columns}
074       lv1,lv2,k  : Integer; {counter-variables}
075       Zahl       : String;  {variable for the numerical data to be printed into Excel}
076 begin
077   If (Spaltenzahl>25) then
078   begin
079     Writeln(ERROR: TOO MANY COLUMNS. So many data-arrays are not available.');
080     Writeln(' => PROGRAM HAS BEEN STOPPED !');
081     Wait; Wait; Halt;
082   end;
083   Assign(fout,Name); Rewrite(fout); {open File now}
084   For lv1:=0 to Spaltenlaenge do
085   begin
086     For lv2:=1 to Spaltenzahl do
087     begin   {print columns: each line can be formatted individually}
088       If lv2=1  then Str(Erg[lv2,lv1]:19:14,Zahl);
089       If lv2=2  then Str(Erg[lv2,lv1]:19:14,Zahl);
090       If lv2=3  then Str(Erg[lv2,lv1]:19:14,Zahl);
091       If lv2=4  then Str(Erg[lv2,lv1]:19:14,Zahl);
092       If lv2=5  then Str(Erg[lv2,lv1]:19:14,Zahl);
093       If lv2=6  then Str(Erg[lv2,lv1]:19:14,Zahl);
094       If lv2=7  then Str(Erg[lv2,lv1]:19:14,Zahl);
095       If lv2=8  then Str(Erg[lv2,lv1]:19:14,Zahl);
096       If lv2=9  then Str(Erg[lv2,lv1]:19:14,Zahl);
097       If lv2=10 then Str(Erg[lv2,lv1]:19:14,Zahl);
098       If lv2=11 then Str(Erg[lv2,lv1]:19:14,Zahl);
099       If lv2=12 then Str(Erg[lv2,lv1]:19:14,Zahl);
100       If lv2=13 then Str(Erg[lv2,lv1]:19:14,Zahl);
101       If lv2=14 then Str(Erg[lv2,lv1]:19:14,Zahl);
102       If lv2=15 then Str(Erg[lv2,lv1]:19:14,Zahl);
103       If lv2=16 then Str(Erg[lv2,lv1]:19:14,Zahl);
104       If lv2=17 then Str(Erg[lv2,lv1]:19:14,Zahl);
105       If lv2=18 then Str(Erg[lv2,lv1]:19:14,Zahl);
106       If lv2=19 then Str(Erg[lv2,lv1]:19:14,Zahl);
107       If lv2=20 then Str(Erg[lv2,lv1]:19:14,Zahl);
108       If lv2=21 then Str(Erg[lv2,lv1]:19:14,Zahl);
109       If lv2=22 then Str(Erg[lv2,lv1]:19:14,Zahl);
110       If lv2=23 then Str(Erg[lv2,lv1]:19:14,Zahl);
111       If lv2=24 then Str(Erg[lv2,lv1]:19:14,Zahl);
112       If lv2=25 then Str(Erg[lv2,lv1]:19:14,Zahl);
113       For k:=1 to Length(Zahl) do
114       begin   {do not use decimal points, but Commata - for the German version of Excel}
115         If Zahl[k]<>'.' then Write(fout,Zahl[k]);
116         If Zahl[k]='.' then Write(fout,',');
117       end;
118       Write(fout,chr(9));  {Data-separation, Tabulator}
119     end;
120     {Optional: Add a report of the Input-Parameters and the Results:}
121     {I can introduce the data line by line into Excel.}
```

```
122    Write(fout,chr(9));
123    If lv1= 0 then Write(fout,'Protokoll');
124    If lv1= 1 then Write(fout,' ');
125    If lv1= 2 then Write(fout,'Input-Parameters:');
126    If lv1= 3 then Write(fout,'L =    ',L:12:7,   ' Meters, length of the magnets according to (*2 of page 3)');
127    If lv1= 4 then Write(fout,'m =    ',m:12:7,   ' Kilograms, inertial mass of the magnets, in applicable including rotating disk');
128    If lv1= 5 then Write(fout,'Fmax = ',Fmax:12:7,' Newtons holding-force of each magnet');
129    If lv1= 6 then Write(fout,'Xanf = ',Xanf:12:7,' [m]  initial position of the left magnet');
130    If lv1= 7 then Write(fout,'Vanf = ',Vanf:12:7,' [m/s]  initial velocity of the left magnet');
131    If lv1= 8 then Write(fout,'SZ   = ',SZ:12,    '  number of steps for the resolution in time-steps');
132    If lv1= 9 then Write(fout,'delT = ',delT:12,  '  seconds, duration of each single time-step);
133    If lv1=10 then Write(fout,'  ');
134    If lv1=11 then Write(fout,' dimensions for a magnet-rotor setup, to be manufactured in reality:');
135    If lv1=12 then Write(fout,'DU   = ',DU:12:7,  ' Meters, diameter');
136    If lv1=13 then Write(fout,'R    = ',R:12:7,   ' Meters, Radius of the rotation');
137    If lv1=14 then Write(fout,'Umf  = ',Umf:12:7, ' Meters, circumference of the Magnet-Rotor');
138    If lv1=15 then Write(fout,'DR   = ',DR:12,    '  rounds per minute');
139    If lv1=16 then Write(fout,'DR/2 = ',DR/2:12:1,' rounds per minute, if two rotor-discs rotate against each other.');
140    If lv1=17 then Write(fout,'AnzMag=',AnzMag:5, ' Number of magnets per each rotor');
141    If lv1=18 then Write(fout,'ZW    =',ZW:12:7,  ' Meters, real interspaces between the magnets in the rotor');
142    If lv1=19 then Write(fout,' ');
143    If lv1=20 then Write(fout,' results of the calculation:');
144    If lv1=21 then Write(fout,'-> increase of the total energy per each Magnet-Passage: ',dE[SZ]:15,' Joule.');
145    If lv1=22 then Write(fout,'-> duration per each Magnet-Passage: ',(L+ZW)/Vanf:12,' sec.');
146    If lv1=23 then Write(fout,'-> Power-gain per each Magnet-Passage: ',dE[SZ]/((L+ZW)/Vanf):14,' Watt');
147    If lv1=24 then Write(fout,'-> Results is ',AnzMag,' Magnets per Rotor-disk: ',AnzMag*dE[SZ]/((L+ZW)/Vanf):14,' Watts for the complete manget-motor');
148    If lv1=25 then Write(fout,'  ');
149    {Here Option-End: report of the input-parametrs and the results.}
150    Writeln(fout,'');    {line-feed (in Excel)}
151   end;
152   Close(fout);
153  end;
154
155  Function F(r1,r2:Double):Double; {magnetic force between two poles in the distance "dist"}
156  Var merk,dist,ddl : Double;
157  begin
158   dist:=Abs(r1-r2); ddl:=dist/L;
159   merk:=0;
160   If (r1<r2) then merk:=-1;
161   If (r1>r2) then merk:=+1;
162   If dist>L then merk:=L*L/dist/dist*(r1-r2)/dist;
163   If (dist<L)and(dist>1E-100) then merk:=(15/8*ddl*ddl*ddl*ddl*ddl-21/4*ddl*ddl*ddl+35/8*ddl)*(r1-r2)/dist;
164   F:=merk/PolMax*Fmax;
165  end;
166
167  {*************************************  Begin of the main program (body)  ********************************************}
168  Begin
169   Writeln(' Two magnets running in opposite directions against each other, acting as converter of zero point energy:');
170   {Initialisation of the constants of nature:}
171   epo:=8.8542E-12;  {A*s/V/m}
172   muo:=4*pi*1E-7;   {V*s/A/m}
173   c:=Sqrt(1/epo/muo);
174   Writeln; Writeln('Vvacuum speed of light: c = ',c:12:4,' m/s');
175   {Initialisation of the values for the setup:}
176   L:=0.04;                    {Length of the magnets according to (*2 of page 3)}
177   ZW:=0.07;                   {Minimum of the interspaces between the magnets in the rotor}
178   m:=0.2;                     {Inertial mass of the magnets, if applicable including the rotating disc}
179   PolMax:=1.6370957061291771521;  {Maximum in the polynomial}
180   Fmax:=80;                   {holding-force of the magnets in Newtons}
181   Xanf:=-0.20;                {[m]    initial position of the left magnet}
182   Vanf:=2E4;                  {[m/s]   initial velocity of the left magnet}
183   Aanf:=0;                    {[m/s^2] initial acceleration of the left magnet}
184   SZ:=5000;                   {Number of steps for the resolution in time-steps}
```

```
185  delT:=40E-10;                  {Seconds, the duration of each single time-step}
186  {Dimensions for the setup of the magnetmotor-rotor as being manufacturable in reality:}
187  DU:=1.5;                       {Meters, diameter}
188  {dimensions, which result from the values given above -> these are not input-parameters, but they are calculated:}
189  R:=DU/2;                       {Radius of the rotation}
190  Umf:=2*pi*R;                   {Meters, circumference of the magnet-rotor}
191  om:=Vanf/R;                    {omega in radiants/second., Initial angular-velocity of the rotation}
192  DR:=(om/2/pi)*60;              {rounde per minute}
193  AnzMag:=Trunc(Umf/(L+ZW));           {number of magnets per each rotor}
194  ZW:=(Umf-AnzMag*L)/AnzMag;           {real interspaces between the magnets inside the rotor}
     If (AnzMag mod 2)=1 then AnzMag:=AnzMag+1;  {use only an even number of magnets !    This line was introduced retroactively , MMDR_03g)
195  Writeln('Circumference of the magnet-rotor ',Umf:9:3,' Meters');
196  Writeln('Rounds per minute: ',DR,' U/min  mit omega = ',om:11,' rad/sec.');
197  Writeln('Number of magnets per each rotor: ',AnzMag);
198  Writeln('Length oft he magnets:                ',L:14:6,' Meters');
199  Writeln('Real interspaces between the magnets: ',ZW:14:6,' Meter');
200  Wait; Wait;
201
202  {This is a test of the force-travel characteristics of the magnet   --> into Excel:}
203  For I:=0 to SZ do begin Erg[ 1,I]:=0; Erg[ 2,I]:=0; end;
204  For I:=0 to SZ do
205  begin
206    X[I]:=(I-SZ/2)/(SZ/2)*5*L;
207    Erg[ 1,I]:=X[I];          {Column: value of the position into Excel}
208    Erg[ 2,I]:=F(X[I],-X[I]);   {Column: value of the force of interaction into Excel}
209  end;
210
211  {Here, I start the trajectory, which I will calculate next:}
212  X[0]:=Xanf;  V[0]:=Vanf;  A[0]:=Aanf; {insert initial values.}
213  Erg[ 3,0]:=0;  T[0]:=0;          {initial time into Excel}
214  Erg[ 4,0]:=X[0];                 {initial position into Excel}
215  Erg[ 5,0]:=V[0];                 {initial velocity into Excel}
216  Erg[ 6,0]:=A[0];                 {initial accceleration into Excel}
217  dE[0]:=0;  E[0]:=0;              {At the very beginning, there is not yet energy-alteration, two types of calculation.}
218
219  {SO -> Now I develop the solution of the differential-equation of the motion, under backtracking of the trajectory:}
220  {I begin with step number zero, at first with its initial starting position:}
221  Techt:=T[0]-2*Abs(X[0])/c;  Xecht:=1;
222 { Writeln ('Techt, Xecht: ',Techt:15,' ,  ',Xecht:10:6); }
223  Tfeld:=(Xecht-X[0])/c;         {nach (*1 von S.18)}
224  Tpartner:=(Xecht+X[0])/V[0];    {nach (*2 von S.18)}
225 { Writeln('Xecht-X[0]: ',Xecht-X[0]:15:7,' und Xecht+Xpartner[0]: ',Xecht+X[0]:15:7); }
226 { Writeln ('Tfeld, Tpartner: ',Tfeld:15,' ,  ',Tpartner:15); Writeln; }
227  {With these values, I can now begin the iteration-step number zero:}
228  {Hint: for the very first start, the speed of light allways leads to a larger distance, than the motion of the partner.}
229  IterFak:=1.2;  tut1:=false;  tut2:=false;
230  Repeat
231    If Tfeld<Tpartner then begin Xecht:=X[0]+(Xecht-X[0])/IterFak; tut1:=true; end;
232    If Tfeld>Tpartner then begin Xecht:=X[0]+(Xecht-X[0])*IterFak; tut2:=true; end;
233    If (tut1=true)and(tut2=true) then
234    begin
235      tut1:=false; tut2:=false;
236      IterFak:=1+((IterFak-1)/10);
237    end;
238    Tfeld:=(Xecht-X[0])/c;             {according to (*1 of page 18)}
239    Tpartner:=(Xecht+X[0])/V[0];    {according to (*2 of page 18)}
240 {  Writeln('IterFak = ',IterFak:10:7,'  tut1=',tut1,' ,  tut2=',tut2); }
241 {  Writeln('Xecht-: ',Xecht:15:7); }
242 {  Writeln ('Tfeld, Tpartner: ',Tfeld:15,' ,  ',Tpartner:15); }
243  Until Abs(IterFak-1)<1E-14;
244  Techt:=T[0]-Tpartner;
245  Writeln ('Iteration-step number ZERO: Techt = ',Techt:15,' ,  Xecht = ',Xecht:10:6);
246  XWW[0]:=Xecht;    TWW[0]:=Techt;     Writeln;
```

```
247   Erg[7,0]:=TWW[0]; Erg[8,0]:=XWW[0];
248   Erg[9,0]:=-X[0];     Erg[10,0]:=XWW[0]+X[0];
249   Erg[11,0]:=dE[0];   Erg[12,0]:=E[0];
250   {Now, step number ZERO of the iteration is ready.}
251
252   {Now I prolong the trajectory backwards, in order to get search with in the trajectory:}
253   T[-1]:=Techt;  X[-1]:=X[0]-V[0]*Abs(Techt); V[-1]:=V[0]; A[-1]:=0; {no acceleration at all, before the very start of the trajectory.}
254  { Writeln(Backtracking: -1.st point of the trajectory: T[-1]=',T[-1]:12);             }
255  { Writeln('=> X[-1]=',X[-1]:8:5,', V[-1]=',V[-1]:8:5,' , A[-1]=',A[-1]:8:5);     Writeln; }
256   {Now I have a backwards prolonged trajectory from -1..SZ, within which the total motion of the magnets and of the field-components can be computed.}
257
258   {Now we pass by step for step through all further steps of the iteration of the trajectory:}
259   For I:=1 to SZ do
260   begin
261  {   Writeln(Step numer.',I,'  -> approximated initial-conditions:'); }
262     {Approximation of the values of step number „I“ (without the finite speed of propagation of the fields), so that I get initial values, for}
263     { the calculation of the field-start-position:}
264     T[I]:=T[I-1]+delT;    {The time is running equidistant}
265     A[I]:=F(X[I],-X[I])/m;   Aca:=A[I];
266  {   Writeln('Ca. Magnetkraft: ',F(X[i],-X[i]):14,' Newton  , Beschl.: ',Aca:14,' m/s^2'); }
267     V[I]:=V[I-1]+A[I]*delT;  Vca:=V[I];
268     X[I]:=X[I-1]+V[I]*delT;  Xca:=X[I];
269  {   Writeln('A[',I,']=',A[I]:14,',  V[',I,']=',V[I]:14,',  X[',I,']=',X[I]:14:8);  }
270     J:=I;
271     Repeat
272       J:=J-1;
273       Xecht:=-X[J]; Techt:=T[J];     {Localisation of the field-start at the interaction-partner now}
274       Tfeld:=Abs(+Xecht-X[I])/c;    {runtime of the field according to (*1 of paage 18), absolute value, because the field can propagate into both directions.}
275       Tpartner:=T[I]-Techt;          {determine the runtime of the interaction-partner}
276       {Writeln('I = ',I,' ,  J = ',J,' => X[I] = ',X[I]:12:7,' Xecht = ',Xecht:12:7);}
277       {Writeln('Tfeld = ',Tfeld:14,', Tpartner = ',Tpartner:14);}
278     Until Tpartner>=Tfeld;       {"J" marks only the very last point, which is at the time BEFORE the position of the field-start.}
279     {In the following, I have to interpolate the trajectory between point number “J” and point number “J+1”:}
280     {I do this with the use of a classical nested intervals calculation:}
281     {Fundamental decision: I use the time as orientation, so that I do not have to invert the squared function of the constantly accelerated motion}
282                                       of the magnets. -> see (*1 of page 20)}
283     {Writeln; Writeln('The Interpolation is following now between point no."J"=',J,' and point no."J+1"=',J+1,':');}
284     Tgl:=T[J];            {left border of the interval for the time}
285     Tgr:=T[J+1];          {right border of the interval for the time }
286     Xgl:=-X[J];           {left border of the interval for the position of the partner}
287     Xgr:=-X[J+1];         {right border of the interval for the position of the partner}
288     Repeat
289       Tgm:=(Tgr+Tgl)/2;                                          {middle of the interval for the time}
290       Xgm:=Xgl-1/2*A[J]*(Tgm-Tgl)*(Tgm-Tgl)-V[J]*(Tgm-Tgl);     {middle of the interval for the position, calculated from the motion with constant acceleration.}
291       {Writeln('Tgl=',Tgl:12,' Tgm=',Tgm:12,' Tgr=',Tgr:12);}
292       {Writeln('Xgl=',Xgl:12:7,' Xgm=',Xgm:12:7,' Xgr=',Xgr:12:7);}
293       {Wait; Wait;}
294       {Now I have to care, that the runtime-values fit to each other:}
295       TlaufPartL:=T[I]-Tgl;
296       TlaufPartR:=T[I]-Tgr;
297       TlaufPartM:=T[I]-Tgm;
298       TlaufFeldL:=Abs(+Xgl-X[I])/c;
299       TlaufFeldR:=Abs(+Xgr-X[I])/c;
300       TlaufFeldM:=Abs(+Xgm-X[I])/c;
301       {Writeln('TlaufPartL=',TlaufPartL:12,' TlaufPartM=',TlaufPartM:12,' TlaufPartR=',TlaufPartR:12);}
302       {Writeln('TlaufFeldL=',TlaufFeldL:12,' TlaufFeldM=',TlaufFeldM:12,' TlaufFeldR=',TlaufFeldR:12);}
303       If TlaufFeldM>TlaufPartM then {moment of time for testing "Tgm" , it is later then the correct moment of time}
304       begin
305         Tgr:=Tgm;
306         Xgr:=Xgm;
307         {Writeln('Step of interpolation: Tgr:=Tgm <-  choose earlier moment of time.');}
308       end;
309       If TlaufFeldM<TlaufPartM then {moment of time for testing "Tgm" , it is earlier then the correct moment of time}
```

```
      begin
        Tgl:=Tgm;
        Xgl:=Xgm;
        {Writeln('Step of interpolation: Tgl:=Tgm <- choose later moment of time.');}
      end;
    Until Abs(Xgl-Xgr)<Abs(X[0])*1E-7;  {calculation with a precision of seven decimal digits behind the decimal point.}
{   Writeln('Step',I,' ==>  Result: real position of the field-start: ',Xgm:12:7); }
    {With the rael position of the field-start, I now have to calculate the magnetic force, and there from the trajectory under consideration}
    {of the finite propagation speed of the interacting field:}
    A[I]:=F(X[I],Xgm)/m;
{   Writeln(Exact (!) magnetic force: ',F(X[I],Xgm):14,' Newtons, acceleration.: ',A[I]:14,' m/s^2'); }
    V[I]:=V[I-1]+A[I]*delT;
    X[I]:=X[I-1]+V[I]*delT;
{   Writeln('A[',I,']=',A[I]:14,',  V[',I,']=',V[I]:14,',  X[',I,']=',X[I]:14:8);  }
{   Writeln('Crucial important differences: A[I]-Aca: ',A[I]-Aca:11,' m/s^2');  }
{   Writeln('                        V[I]-Vca: ',V[I]-Vca:11,' m/s,  X[I]-Xca: ',X[I]-Xca:11,' m');  }
    {Storage of the data for the later evaluation of the trajectories:}
    Erg[ 3,I]:=T[I];      {Moment of time into Excel}
    Erg[ 4,I]:=X[I];      {Value of the position into Excel}
    Erg[ 5,I]:=V[I];      {Value of the velocity into Excel}
    Erg[ 6,I]:=A[I];      {Value of the acceleration into Excel}
    TWW[I]:=Tgm;      XWW[I]:=Xgm;
    Erg[7,I]:=TWW[I]; Erg[8,I]:=XWW[I];
    Erg[9,I]:=-X[I];  Erg[10,I]:=XWW[I]+X[I];
{   Writeln('Auswertung: deltaV = ',(V[I]-V[0])); }
    dE[I]:=m/2*(2*V[0]*(V[I]-V[0])+(V[I]-V[0])*(V[I]-V[0]));  {nach (*1 von S.22)}
    E[I]:=E[I-1]+m*A[I]*(X[I]-X[I-1]);
    Erg[11,I]:=dE[I];
    Erg[12,I]:=E[I];
    {Wait; Wait;}
  end;
  Writeln; Writeln('   ->  total energy increase per each Magnet-Passage: ',dE[SZ]:15,' Joules.'); Writeln;

  {A data-evaluation "I fit would be a rotor" will now follow.}
  Writeln('Running-duration per each Magnet-passage: ',(L+ZW)/Vanf:12,' sec.');
  Writeln('Power-gain per each Magnet: ',dE[SZ]/((L+ZW)/Vanf):14,' Watt');
  Writeln('Result for ',AnzMag,' Magnets: ',AnzMag*(E[SZ]-E[0])/((L+ZW)/Vanf):14,' Watts for the total Manget-motor');
  Writeln;

  {And now the data have to be exported into Excel: Therefore, the Version-Numbers are counted automatically.}
  Spaltenzahl:=12; Spaltenlaenge:=SZ;
  Writeln('Polite question of the Computer: Shall I write a data-report for you ?');
  Write(' < N = No / S = Store(yes) / T = Test without Version-number > ');
  Read(Kieh); Write(Kieh);
  If Kieh='n' then Kieh:='N';
  If Kieh='s' then Kieh:='S';
  If Kieh='t' then Kieh:='T';
  If Kieh='S' then
  begin
    ZaehlnummerLesen;
    ExcelAusgabe(Versionsname);
  end;
  If Kieh='T' then
  begin
    ExcelAusgabe('Test.xls');
    Writeln('  =>  Data-storage of the calculation was done into the Excel-File: Test.xls');
  end;
  If (Kieh='S')or(Kieh='T') then
  begin
    Write('       Ready  -> By,by.   ');
    Wait; Wait; Wait;
  end;
End.
```

9.2 Source-Code of the Algorithms („Dgl_Loeser_004c“ and „…_005“) [Bor 99]

The lines in red numbers in front and with the source-code written in black colour, represent the algorithm „Dgl_Loeser_004c“, to which the sections 6.1 – 6.4 refer. The lines, which are written completely in green colour, are the addings made for section 6.5, for the algorithm „Dgl_Loeser_005“. They are discussed only in section 6.5 (not earilier). Additionally, in purple colour, a parameter-recording for the Excel-results-file was inserted (see the lines after “096” with small and large letters), which has the task to write the complete set of input-parameters into the Excel-results-file, and also those output-parameters, which are displayed onto the screen. This has the purpose, that always all graphical plots and all results can be clearly assigned, to their corresponding input-parameters.

```
001 Program Dgl_Loeser_004c;
002 {$APPTYPE CONSOLE}
003 uses
004   Windows, Messages, SysUtils, Classes, Graphics, Controls, Forms, Dialogs;
005  { Copyright by   Prof. Dr. C. Turtur  ,  Wolfenbüttel }
006 Const ExcelMax=5000; RueckblickMAX=5000;
007
008 Var I1_alt,I2_alt,I1p_alt,I2p_alt : Double; {current: "I" and its time-derivative: "Ip", two currents}
009     I1_neu,I2_neu,I1p_neu,I2p_neu : Double; {current: "I" and its time-derivative: "Ip", two currents }
010     n1,n2          : Integer; {number of windings of the coils}
011     muo            : Double;  {constant of nature}
012     mur            : Double;  {material constant of yoke}
013     Laen1,Rad1,Laen2,Rad2 : Double;  {length and radius of the coils}
014     A              : Double;  {cross-section area of yoke}
015     L11,L12,L22,L21 : Double;  {inductances}
016     R1,R2          : Double;  {Ohmic resistances}
017     RV1,RV2        : Double;  {Ohmic consumer-resistors}
018     RSp1,RSp2      : Double;  {portion of the coil wire on the Ohmic resistance}
019     DD1,DD2        : Double;  {thickness of the wires, given as diameter}
020     rho            : Double;  {specific resistance of the copper in the coils' wires}
021     t,tanf,dt,tend  : Double;  {continuously running time and time-steps}
022     I,Imax         : Int64;   {counter-variable "I" and number of computation-points "Imax"}
023     Dauer          : Real;    {estimated duration for the work of the differential-equation-solver}
024     hh,mm,ss       : Integer; {estimated duration for the work of the differential-equation-solver}
025     ExcelSteps     : LongInt; {distance between the data-points being exported to the Excel-record-file}
026     Spaltenzahl,Spaltenlaenge : LongInt; {size of the Excel-record-file}
027     Erg : Array [1..25,0..ExcelMax] of Real; {the results to be exported to Excel}
028     Protokoll      : Boolean; {does the user want to have an Excel-record-file ?}
029     Prozent_fertig : Boolean; {Shall the computer print the progress of the computation ?}
030     Delay,j        : LongInt;   {FPSIF time-delay in the yoke}
031     I1_rueck,I2_rueck   : Array [-RueckblickMAX..0] of Double; {maximal number of retrospective steps}
032     I1p_rueck,I2p_rueck : Array [-RueckblickMAX..0] of Double; {maximal number of retrospective steps}
033     Ener_Uext : Double; {energy being inserted via Uext}
034     Ener_R1   : Double; {power losses in the Ohmic resistance of the primary coil}
035     Ener_R2   : Double; {energy being extracted via R2}
036     Ener_Sp1,Ener_V1 : Double; {Energy via coil_1 and via consumer_1}
037     Ener_Sp2,Ener_V2 : Double; {Energy via coil_2 and via consumer_2}
038     Kieh           : Char;   {End of program}
039     SchaukelSensibilitaet : Real;
040     Glaettungsstrecke     : LongInt;
040a    Q1, Q2   : Double;  {electrical charges as integrals over the currents}
040b    C1, C2   : Double;  {capacities of the capacitors for the LC-oscillation circuits according to Fig.N10}
041
042 Procedure Wait;
043 Var Ki : Char;
044 begin
045   Write('<W>'); Read(Ki); Write(Ki);
046   If Ki='e' then Halt;
047 end;
048
049 Procedure ExcelAusgabe(Name:String);  {procedure to write the data into the Excel-record-file}
050 Var fout      : Text;    {timescale with up to 25 data-columns}
051   Iv1,Iv2,k : Integer; {running variables}
052   Zahl      : String;  {the figures, which have to be written into the Excel-record-file}
053 begin
054   If (Spaltenzahl>25) then
055   begin
```

```
056    Writeln('ERROR: Too many columns. So many data-Arrays are not available.');
057    Writeln(' => PROGRAM WAS TERMINATED: STOP !');
058    Wait; Wait; Halt;
059   end;
060   Assign(fout,Name); Rewrite(fout); {Open the File}
061   For lv1:=0 to Spaltenlaenge do
062   begin
063    For lv2:=1 to Spaltenzahl do
064    begin   {Write columns: each lines can be individually formatted in the following command-lines.}
065     If lv2=1  then Str(Erg[lv2,lv1]:19:14,Zahl);
066     If lv2=2  then Str(Erg[lv2,lv1]:19:14,Zahl);
067     If lv2=3  then Str(Erg[lv2,lv1]:19:14,Zahl);
068     If lv2=4  then Str(Erg[lv2,lv1]:19:14,Zahl);
069     If lv2=5  then Str(Erg[lv2,lv1]:19:14,Zahl);
070     If lv2=6  then Str(Erg[lv2,lv1]:19:14,Zahl);
071     If lv2=7  then Str(Erg[lv2,lv1]:19:14,Zahl);
072     If lv2=8  then Str(Erg[lv2,lv1]:19:14,Zahl);
073     If lv2=9  then Str(Erg[lv2,lv1]:19:14,Zahl);
074     If lv2=10 then Str(Erg[lv2,lv1]:19:14,Zahl);
075     If lv2=11 then Str(Erg[lv2,lv1]:19:14,Zahl);
076     If lv2=12 then Str(Erg[lv2,lv1]:19:14,Zahl);
077     If lv2=13 then Str(Erg[lv2,lv1]:19:14,Zahl);
078     If lv2=14 then Str(Erg[lv2,lv1]:19:14,Zahl);
079     If lv2=15 then Str(Erg[lv2,lv1]:19:14,Zahl);
080     If lv2=16 then Str(Erg[lv2,lv1]:19:14,Zahl);
081     If lv2=17 then Str(Erg[lv2,lv1]:19:14,Zahl);
082     If lv2=18 then Str(Erg[lv2,lv1]:19:14,Zahl);
083     If lv2=19 then Str(Erg[lv2,lv1]:19:14,Zahl);
084     If lv2=20 then Str(Erg[lv2,lv1]:19:14,Zahl);
085     If lv2=21 then Str(Erg[lv2,lv1]:19:14,Zahl);
086     If lv2=22 then Str(Erg[lv2,lv1]:19:14,Zahl);
087     If lv2=23 then Str(Erg[lv2,lv1]:19:14,Zahl);
088     If lv2=24 then Str(Erg[lv2,lv1]:19:14,Zahl);
089     If lv2=25 then Str(Erg[lv2,lv1]:19:14,Zahl);
090     For k:=1 to Length(Zahl) do
091     begin   {My German version of Excel does not use decimal-points but kommata.}
092      If Zahl[k]<>'.' then Write(fout,Zahl[k]);
093      If Zahl[k]='.' then Write(fout,',');
094     end;
095     Write(fout,chr(9));  {data-separation, tabulator}
096    end;
096a  {Optional: a protocol of all the input-parameters and of the results can be added to the Excel-record-file:}
096b  {I can write the contents line by line into the Excel-record-file:}
096c  Write(fout,chr(9));
096d  If lv1= 0 then Write(fout,'Protocol');
096e  If lv1= 1 then Write(fout,' ');
096f  If lv1= 2 then Write(fout,'Real Input-Parameters:');
096g  If lv1= 3 then Write(fout,'Number of windings of the coils: n1=',n1,'  und  n2=',n2);
096h  If lv1= 4 then Write(fout,'Length and radios of coil number 1 in Meters: Laen1=',Laen1:10:7,'  und  Rad1=',Rad1:10:7);
096i  If lv1= 5 then Write(fout,'Length and radios of coil number 2 in Meters: Laen2=',Laen2:10:7,'  und  Rad2=',Rad2:10:7);
096j  If lv1= 6 then Write(fout,'Wire-thickness, diameter of the coils' wires in Meters: DD1=',DD1:10:7,'  und  DD2=',DD2:10:7);
096k  If lv1= 7 then Write(fout,'Cross-section area of the yoke in square-metres = m^2: ',A:10:7);
096l  If lv1= 8 then Write(fout,'Material-constant of the yoke, (without physical unit), mur = ',mur:10:5);
096m  If lv1= 9 then Write(fout,'yoke-delay, given as the number of computation-steps of "dt": Delay = ',Delay);
096n  If lv1=10 then Write(fout,'Ohmic resistances, given with the unit of Ohms: R1=',R1:9:5,'  und  R2=',R2:9:5);
096o  If lv1=11 then Write(fout,'Time, time-steps and end of time in seconds: tanf=',tanf:12,' ;  dt=',dt:12,' ;  tend=',tend:12);
096p  If lv1=12 then Write(fout,'Spezific resistance of the copper in the coils' wires, in Ohm*m²/m : rho=',rho:14);
096q  If lv1=13 then Write(fout,'Parameter "SchaukelSensibilitaet" : ',SchaukelSensibilitaet:12);
096r   If lv1=14 then Write(fout,'Parameter "Glaettungsstrecke" : ',Glaettungsstrecke);
096s  If lv1=15 then Write(fout,'Capacities of the capacitors in the LC-oscillation circuits according to Fig.N10 : C1=',C1:9:5,'  und  C2=',C2:9:5);
096t  If lv1=16 then Write(fout,' ');
096u  If lv1=17 then Write(fout,'Affiliated Parameters:');
096v  If lv1=18 then Write(fout,'Portion of the coil wire on the Ohmic resistance of coil number 1, in the unit of Ohms: RSp1=',RSp1:9:5);
096w  If lv1=19 then Write(fout,'Portion of the coil wire on the Ohmic resistance of coil number 2, in the unit of Ohms, in the unit of Ohms: RSp2=',RSp2:9:5);
096x  If lv1=20 then Write(fout,'Ohmic consumer resistance in the primary circuit, given in the unit of Ohms: RV1=',RV1:9:5);
096y  If lv1=21 then Write(fout,'Ohmic consumer resistance in the secondary circuit, given in the unit of Ohms: RV2=',RV2:9:5);
096z  If lv1=22 then Write(fout,'Additional Ohmic consumers: RV1 = ',RV1:9:5, ' Ohm; und RV2 = ',RV2:9:5, ' Ohm');
096A  If lv1=23 then Write(fout,'Inductances:  L11 = ',L11:11,'  und  L12 = ',L12:11);
096B  If lv1=24 then Write(fout,'Inductances:  L21 = ',L21:11,'  und  L22 = ',L22:11);
096C  If lv1=25 then Write(fout,'  ');
096D  If lv1=26 then Write(fout,'*******************************************************************************');
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096E   If lv1=27 then Write(fout,'  ');
096F   If lv1=28 then Write(fout,'  ');
096G   If lv1=29 then Write(fout,'Results:  ');
096H   If lv1=30 then Write(fout,'Ener_Uext = Uext*I1*dt = ',Ener_Uext:10:5,'Joules');
096I    If lv1=31 then Write(fout,'Ener_R1 = R1*I1^2*dt = ',Ener_R1:12:5,' J;    Ener_Sp1 = ',Ener_Sp1:10:5,'J;      Ener_consumer_1 = ',Ener_V1:10:5,'J');
096J    If lv1=32 then Write(fout,'Ener_R2 = R2*I2^2*dt = ',Ener_R2:12:5,' J;    Ener_Sp2 = ',Ener_Sp2:10:5,'J;      Ener_consumer_2 = ',Ener_V2:10:5,'J');
096K   If lv1=33 then Write(fout,'For the purpose of comparison:    Ener_Uext + Ener_R2 = ',Ener_Uext+Ener_R2:12:5,' J');
096L    If lv1=34 then Write(fout,'Control: (Ener_Uext+Ener_R2)-Ener_R1= ',(Ener_Uext+Ener_R2)-Ener_R1:15,' Joules for computation-uncertainty plus FPSIF-
                                                                                                                                    -energy-conversion');
096M   If lv1=35 then Write(fout,' ');
096N    {Here: end of the option to record the Input-Parameters and the results to the Excel-file.}
097     Writeln(fout,'');    {line-separation}
098    end;
099    Close(fout);
100  end;
101
102  Procedure Glaettung(Stelle:LongInt);
103  Var Zeile,j : LongInt;
104     X,Y : Array [0..RueckblickMAX] of Double;
105     Sx4,Sx3,Sx2,Sx,Sy,Sxy,Sx2y : Double;
106     I,n : LongInt;  {I=running-variable; n=number of data-pairs}
107     A,B,C : Real; {Coefficients}
108  begin
109  { Writeln; Writeln('Smoothing-procedure; range for supervision and smoothing begins at = ',Stelle,' : '); }
110  { Writeln('AT FIRST FOR THE TIME-DERIVE OF THE PRIMARY CURRENT:'); }
111  { Writeln('j   :    I1_rueck[j]      I2_rueck[j]     I1p_rueck[j]     I2p_rueck[j]'); }
112  { For j:=(-Delay-Glaettungsstrecke) to 0 do {remark positions retrospectively for the delay-distance plus "Glaettungsstrecke"}
113    begin
114     Writeln(j:3,':  ',I1_rueck[j]:15:6,'   ',I2_rueck[j]:15:6,'   ',I1p_rueck[j]:15:6,'   ',I2p_rueck[j]:15:6);
115    end;    Writeln; }
116    {'Smoothing of "I1Punkt" (the derivative of I1) begins from here on, the data are taken as a copy from the File Parabeil_Fit:}
117    n:=Delay+Glaettungsstrecke+1;
118  { Writeln(n,' data-pairs '); }
119    For i:=0 to Delay+Glaettungsstrecke do
120    begin
121     X[i]:=i;
122     Y[i]:=I1p_rueck[i-Delay-Glaettungsstrecke];
123  {   Writeln(i:3,': ',X[i]:7:2,' ,  ',y[i]:14:7); }
124    end;
125    Sx4:=0; Sx3:=0; Sx2:=0; Sx:=0; Sy:=0; Sxy:=0; Sx2y:=0;
126    For i:=0 to n-1 do
127    begin
128     Sx4:=Sx4+X[i]*X[i]*X[i]*X[i];
129     Sx3:=Sx3+X[i]*X[i]*X[i];
130     Sx2:=Sx2+X[i]*X[i];
131     Sx:=Sx+X[i];
132     Sy:=Sy+Y[i];
133     Sxy:=Sxy+X[i]*Y[i];
134     Sx2y:=Sx2y+X[i]*X[i]*Y[i];
135    end;
136  { Writeln('Sx4: ',sx4:15:11); Writeln('Sx3: ',sx3:15:11); Writeln('Sx2: ',sx2:15:11); Writeln('Sx: ',sx:15:11);
137    Writeln('Sy: ',sy:15:11);   Writeln('Sxy: ',sxy:15:11);  Writeln('Sx2y: ',sx2y:15:11); }
138    {Coefficients are calculated now:}
139    A:=-sx2y*sx*sx+sx*sx2*sxy+sx*sx3*sy+n*sx2y*sx2-n*sxy*sx3-sy*sx2*sx2;
140    A:=A/(-sx2*sx2*sx2+2*sx3*sx2*sx-sx4*sx*sx-sx3*sx3*n+n*sx2*sx4);
141    B:=sx2y*sx*sx2-sx3*sx2y*n+sx4*sxy*n-sx2*sx2*sxy+sx3*sy*sx2-sy*sx4*sx;
142    B:=B/(-sx2*sx2*sx2+2*sx3*sx2*sx-sx4*sx*sx-sx3*sx3*n+n*sx2*sx4);
143    C:=-sx2y*sx2*sx2+sx3*sx2y*sx-sx4*sxy*sx+sx2*sxy*sx3-sx3*sx3*sy+sy*sx2*sx4;
144    C:=C/(-sx2*sx2*sx2+2*sx3*sx2*sx-sx4*sx*sx-sx3*sx3*n+n*sx2*sx4);
145  { Writeln('Coefficients:'); }
146  { Writeln('  A = ',A:15:11); }
147  { Writeln('  B = ',B:15:11); }
148  { Writeln('  C = ',C:15:11); }
149    {Display of the data-pairs and of the regression parable:}
150  { Writeln('j   :   X[i]            Y[i]       A*i*i+B*i+C'); }
151  { For i:=0 to (Delay+Glaettungsstrecke) do Writeln(i:3,': ',X[i]:7:2,' ,  ',y[i]:14:7,' ,  ',(A*i*i+B*i+C):14:7); }
152    {Options for the control in Excel:
153    For j:=(-Delay-Glaettungsstrecke) to 0 do
154    begin
155     Zeile:=j+Delay+Glaettungsstrecke;
156     Erg[1,Zeile]:=Zeile;
```

```
157    Erg[2,Zeile]:=I1_rueck[j];
158    Erg[3,Zeile]:=I2_rueck[j];
159    Erg[4,Zeile]:=I1p_rueck[j];
160    Erg[5,Zeile]:=I2p_rueck[j];
161    Erg[6,Zeile]:=X[Zeile];
162    Erg[7,Zeile]:=Y[Zeile];
163    Erg[8,Zeile]:=(A*Zeile*Zeile+B*Zeile+C)
164   end;
165   Spaltenlaenge:=Delay+Glaettungsstrecke; Spaltenzahl:=8;
166   ExcelAusgabe('Test.xls');   }
167   For j:=(-Delay-Glaettungsstrecke) to 0 do
168   begin
169    Zeile:=j+Delay+Glaettungsstrecke; I1p_rueck[j]:=(A*Zeile*Zeile+B*Zeile+C);
170   end;
171  { Writeln('j   :    I1_rueck[j]      I2_rueck[j]     I1p_rueck[j]     I2p_rueck[j]'); }
172  { For j:=(-Delay-Glaettungsstrecke) to 0 do {remark positions retrospectively for the “Delay” plus for the "Glaettungsstrecke", for the purpose of smoothing
173   begin
174    Writeln(j:3,':  ',I1_rueck[j]:15:6,'   ',I2_rueck[j]:15:6,'   ',I1p_rueck[j]:15:6,'   ',I2p_rueck[j]:15:6);
175   end; }
176  { Writeln; Writeln('NOW REPEAT THE SAME PROCEDURE, NAMELY FOR THE TIME-DERIVE OF THE SECONDARY-CURRENT:'); }
177  { Writeln('j   :    I1_rueck[j]      I2_rueck[j]     I1p_rueck[j]     I2p_rueck[j]'); }
178  { For j:=(-Delay-Glaettungsstrecke) to 0 do {remark positions retrospectively for the delay-distance plus "Glaettungsstrecke"
179   begin
180    Writeln(j:3,':  ',I1_rueck[j]:15:6,'   ',I2_rueck[j]:15:6,'   ',I1p_rueck[j]:15:6,'   ',I2p_rueck[j]:15:6);
181   end;    Writeln; }
182   {Smoothing of "I1Punkt" (the time-derivative) begins from here on, the data are taken as a copy from the File Parabeil_Fit:}
183   n:=Delay+Glaettungsstrecke+1;
184  { Writeln(n,' data-pairs '); }
185   For i:=0 to Delay+Glaettungsstrecke do
186   begin
187    X[i]:=i;
188    Y[i]:=I2p_rueck[i-Delay-Glaettungsstrecke];
189  {   Writeln(i:3,': ',X[i]:7:2,' ,  ',y[i]:14:7); }
190   end;
191   Sx4:=0; Sx3:=0; Sx2:=0; Sx:=0; Sy:=0; Sxy:=0; Sx2y:=0;
192   For i:=0 to n-1 do
193   begin
194    Sx4:=Sx4+X[i]*X[i]*X[i]*X[i];
195    Sx3:=Sx3+X[i]*X[i]*X[i];
196    Sx2:=Sx2+X[i]*X[i];
197    Sx:=Sx+X[i];
198    Sy:=Sy+Y[i];
199    Sxy:=Sxy+X[i]*Y[i];
200    Sx2y:=Sx2y+X[i]*X[i]*Y[i];
201   end;
202  { Writeln('Sx4: ',sx4:15:11); Writeln('Sx3: ',sx3:15:11); Writeln('Sx2: ',sx2:15:11); Writeln('Sx: ',sx:15:11);
203   Writeln('Sy: ',sy:15:11);   Writeln('Sxy: ',sxy:15:11);  Writeln('Sx2y: ',sx2y:15:11); }
204   {Calculate the Coeficients:}
205   A:=-sx2y*sx*sx+sx*sx2*sxy+sx*sx3*sy+n*sx2y*sx2-n*sxy*sx3-sy*sx2*sx2;
206   A:=A/(-sx2*sx2*sx2+2*sx3*sx2*sx-sx4*sx*sx-sx3*sx3*n+n*sx2*sx4);
207   B:=sx2y*sx*sx2-sx3*sx2y*n+sx4*sxy*n-sx2*sx2*sxy+sx3*sy*sx2-sy*sx4*sx;
208   B:=B/(-sx2*sx2*sx2+2*sx3*sx2*sx-sx4*sx*sx-sx3*sx3*n+n*sx2*sx4);
209   C:=-sx2y*sx2*sx2+sx3*sx2y*sx-sx4*sxy*sx+sx2*sxy*sx3-sx3*sx3*sy+sy*sx2*sx4;
210   C:=C/(-sx2*sx2*sx2+2*sx3*sx2*sx-sx4*sx*sx-sx3*sx3*n+n*sx2*sx4);
211  { Writeln(' Coeficients:'); }
212  { Writeln('  A = ',A:15:11); }
213  { Writeln('  B = ',B:15:11); }
214  { Writeln('  C = ',C:15:11); }
215  {Display of the data-pairs and of the regression parable:}
216  { Writeln('j   :   X[i]            Y[i]       A*i*i+B*i+C'); }
217  { For i:=0 to Delay+Glaettungsstrecke do
218     Writeln(i:3,': ',X[i]:7:2,' ,  ',y[i]:14:7,' ,  ',(A*i*i+B*i+C):14:7); }
219   {Option for the Control in Excel:
220   For j:=(-Delay-Glaettungsstrecke) to 0 do
221   begin
222    Zeile:=j+Delay+Glaettungsstrecke;
223    Erg[1,Zeile]:=Zeile;
224    Erg[2,Zeile]:=I1_rueck[j];
225    Erg[3,Zeile]:=I2_rueck[j];
226    Erg[4,Zeile]:=I1p_rueck[j];
227    Erg[5,Zeile]:=I2p_rueck[j];
```

```
228    Erg[6,Zeile]:=X[Zeile];
229    Erg[7,Zeile]:=Y[Zeile];
230    Erg[8,Zeile]:=(A*Zeile*Zeile+B*Zeile+C)
231   end;
232   Spaltenlaenge:=Delay+Glaettungsstrecke; Spaltenzahl:=8;
233   ExcelAusgabe('Test.xls');   }
234   For j:=(-Delay-Glaettungsstrecke) to 0 do
235   begin
236    Zeile:=j+Delay+Glaettungsstrecke;
237    I2p_rueck[j]:=(A*Zeile*Zeile+B*Zeile+C);
238   end;
239  { Writeln('j   :    I1_rueck[j]      I2_rueck[j]     I1p_rueck[j]     I2p_rueck[j]'); }
240  { For j:=(-Delay-Glaettungsstrecke) to 0 do {remark positions retrospectively for the delay-distance plus "Glaettungsstrecke"
241   begin
242    Writeln(j:3,':  ',I1_rueck[j]:15:6,'   ',I2_rueck[j]:15:6,'   ',I1p_rueck[j]:15:6,'   ',I2p_rueck[j]:15:6);
243   end;}
244   {Finally: READY}
245   {Writeln; Wait; Wait; Halt;}
246  end;
247
248  Function aufschaukelt:Boolean;
249  Var mueh,sigma : Double;
250    j         : LongInt;
251    merk      : Boolean;
252  begin
253  { Writeln; Writeln('Modul "aufschaukelt",ab I = ',I,' : '); }
254  { Writeln('I1_rueck[j]      I2_rueck[j]     I1p_rueck[j]     I2p_rueck[j]'); }
255  { For j:=(-Delay-Glaettungsstrecke) to -1 do }
256  { begin }
257  {   Writeln(I1_rueck[j]:12:6,'    ',I2_rueck[j]:12:6,'    ',I1p_rueck[j]:12:6,'    ',I2p_rueck[j]:12:6); }
258  { end; }
259   mueh:=0; sigma:=0;
260   For j:=(-Delay-Glaettungsstrecke) to -1 do mueh:=mueh+I1p_rueck[j];
261   mueh:=mueh/Abs(-Delay-Glaettungsstrecke);
262   For j:=(-Delay-Glaettungsstrecke) to -1 do sigma:=sigma+Sqr(mueh-I1p_rueck[j]);
263   sigma:=Sqrt(sigma)/Abs(-Delay-Glaettungsstrecke);
264  { Writeln('mueh = ',mueh:12:7,'  und   sigma = ',sigma:12:7); }
265   merk:=false;
266   If Abs(sigma)>SchaukelSensibilitaet*Abs(mueh) then merk:=true;
267  { Writeln('aufschaukelt = ',merk);   If merk then Wait; }
268   aufschaukelt:=merk;
269  end;
270
271  Function Uext(t:Double):Double;
272  Var Frequ : Real;   {sinus-shaped alternating voltage, frequency in the unit of Hertz}
273     omega : Double; {angular frequency}
274     merk  : Double;
275  begin
276   Frequ:=50; {sinus-shaped alternating voltage, frequency in the unit of Hertz}
277   omega:=2*pi*Frequ;
278   merk:=sin(omega*t);
279  { temporarily for the purpose of testing: }
280   merk:=0*merk;
281   If (0.1*tend<t)and(t<0.6*tend) then merk:=1;
281a  If (0.01*tend<t)and(t<0.02*tend) then merk:=1;
282   Uext:=merk;
283  end;
284
285  Begin {Main program}
286   Writeln('Motionless-Converter -> On the basis of FPSIF-principle, under the solution of an inhomogeneous differential-equation-system');  Writeln;
287   {Real Input-Parameters of the electrical circuits:}
288   n1:=200; n2:=200;       {number of windings of the coils}
289   Laen1:=1E-3; Rad1:=1E-2;  {length and radius of the coil Nr.1 in meters}
290   Laen2:=1E-3; Rad2:=1E-2;  {length and radius of the coil Nr.2 in meters}
291   DD1:=5.0E-3; DD2:=5.0E-3; {thickness of the coils' wires, given as diameter, in the unit of meters}
292   A:=Sqr(4E-3);            {cross-section of the yoke, given in the unit of square-metres = m²}
293   muo:=4*pi*1E-7;          {Constant of nature, given in the unit of  Vs/Am}
294   mur:=1.00;               {material constant of yoke, without physical units}
295   Delay:=10;               {FPSIF time-delay in the yoke, given as the number of times-steps "dt"}
296   R1:=0.02; R2:=0.02;            {Ohmic resistances, given in the physical units of Ohms}
297   tanf:=0; dt:=1E-7; tend:=0.4;   {Time, time-steps and time-end in seconds}
```

```
298  rho:=1/(5.72E7);   {specific resistance of the copper in the coils' wires, given in the unit of Ohm*m²/m}
299  SchaukelSensibilitaet:=0.05;
300  Glaettungsstrecke:=50;
300a C1:=1E-1;  C1:=1E-1;  {capacities of the capacitors in the LC-oscillation-circuit, according to Fig.N10}
301
302  {Affiliated Parameters:}
303  RSp1:=rho*(n1*2*pi*Rad1)/(pi*DD1*DD1); {portion of the coil's wire on the Ohmic resistance, given in the unit of Ohms}
304  RSp2:=rho*(n2*2*pi*Rad2)/(pi*DD2*DD2); {portion of the coil's wire on the Ohmic resistance, given in the unit of Ohms}
305  RV1:=R1-RSp1;  RV2:=R2-RSp2; {Ohmic consumer-resistances, given in the unit of Ohms}
306  Writeln('Ohmic resistances of: coil 1 -> ',RSp1:7:4, ' Ohms; and of coil 2 -> ',RSp2:7:4, ' Ohms');
307  If RSp1>R1 then
308  begin
309    Writeln; Writeln('ERROR:');
310    Writeln('The Ohmic resistance of coil 1 alone, is larger than the total Ohmic resistance in the primary circuit at all.');
311    Wait; Wait; Halt;
312  end;
313  If RSp2>R2 then
314  begin
315    Writeln; Writeln('ERROR:');
316    Writeln('The Ohmic resistance of coil 2 alone, is larger than the total Ohmic resistance in the secondary circuit at all.');
317    Wait; Wait; Halt;
318  end;
319  Writeln('Additional Ohmic consumers are: RV1 = ',RV1:7:4, ' Ohms; and RV2 = ',RV2:7:4, ' Ohms');
320  L11:=(n1*n1*muo*mur)/Sqrt(Laen1*Laen1+Rad1*Rad1)*A;     { inductance }
321  L12:=(n2*n1*muo*mur)/Sqrt(Laen2*Laen2+Rad2*Rad2)*A;     { inductance }
322  L22:=(n2*n2*muo*mur)/Sqrt(Laen2*Laen2+Rad2*Rad2)*A;     { inductance }
323  L21:=(n1*n2*muo*mur)/Sqrt(Laen1*Laen1+Rad1*Rad1)*A;     { inductance }
324  Writeln(' Inductances: L11=',L11:14,'Henry ,  L12=',L12:14,' Henry');
325  Writeln('              L21=',L21:14,'Henry ,  L22=',L22:14,' Henry');
326
327  {Preparation for the run of the differential-equation-solver:}
328  I1_neu:=0;  {I1p_neu:=0;}  I2_neu:=0;  {I2p_neu:=0;}     {initial conditions}
329  For j:=-RueckblickMAX to 0 do
330  begin {Up to now, we do not yet have data in the retrospective storage, for the computation of the yoke-Delay}
331    I1_rueck[j]:=0;  I2_rueck[j]:=0;
332    I1p_rueck[j]:=0; I2p_rueck[j]:=0;
333  end;
334  Ener_Uext:=0; Ener_R1:=0; Ener_R2:=0; {Initial values for the integrals over "power*dt"}
335  Ener_Sp1:=0; Ener_V1:=0;  Ener_Sp2:=0; Ener_V2:=0; {Energy of the consumers and of the coils separately}
336
337  {Now we begin to solve the differential-equation-system:}
338  Imax:=Round((tend-tanf)/dt); {Number of points for the numerical iteration}
339  Dauer:=Imax*28.6E-8*(1+Delay/31.5); {Estimated duration for the work of the differential-equation-solver}
340  Prozent_fertig:=false; If (Imax>7E6) then Prozent_fertig:=true;
341  ExcelSteps:=1;  If Imax<=Excelmax then ExcelSteps:=1;
342  If Imax>Excelmax then ExcelSteps:=Trunc(Imax/Excelmax)+1;
343  Writeln('Time-scale: ',tanf:12,' + n * ',dt:12,' . . . ',tend:12);
344  Writeln('leads to numerical iteration steps: ',Imax);
345  Spaltenlaenge:=-1;   Protokoll:=true; {question, whether an Excel-data-record-file shall be made or not ?}
346  If Protokoll then Writeln('Excel-data-recording: Each ',ExcelSteps,'th step is being recorded.');
347
347a Q1:=0;  Q2:=0;  {electrical charges as integrals over the currents, at the very begin, there are not yet any electrical charge inside the capacitors.}
348  {The central core of the solver-loop:}
349  If Prozent_fertig then
350  begin
351    hh:=Trunc(Dauer/3600); Dauer:=Dauer-hh*3600;
352    mm:=Trunc(Dauer/60);   Dauer:=Dauer-mm*60;
353    ss:=Trunc(Dauer)+1;
354    Write('working-duration:');
355  end;
356  I:=-1;
357  Repeat I:=I+1;
358    t:=tanf+I*dt;
359    I1_alt:=I1_neu;  {I1p_alt:=I1p_neu;}  I2_alt:=I2_neu;  {I2p_alt:=I2p_neu;}
360    For j:=(-Delay-10) to -1 do {Additionally to the "Delay" we want to store 10 further positions, for the purpose of smoothing}
361    begin  {Also the yoke-retrospective must be shifted in time by one step.}
362      I1_rueck[j]:=I1_rueck[j+1];   I2_rueck[j]:=I2_rueck[j+1];
363      I1p_rueck[j]:=I1p_rueck[j+1]; I2p_rueck[j]:=I2p_rueck[j+1];
364    end;
365    {From time to time we have to check, whether the smoothing procedure is necessary, and if "yes", we have to do it:}
366    If ((I mod 10000)=0) then
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367    begin
368      If aufschaukelt then Glaettung(I);
369    end;
370    {  If I1p_rueck[j]<>I1p_rueck[j+1] then    Control of the retrospective, is the check is done
371      Writeln(I,' : jetzt: ',I1p_alt:12,' im Rueckblick: ',I1p_rueck[-Delay]:12); }
372
373    {And now we have two put the data concretely into the differential-equation, in order to determine the solution of the differential-equation:}
374    I1p_alt:=I1p_rueck[-Delay];   {introduce retrospective for the FPSIF-theory}
375    I2p_alt:=I2p_rueck[-Delay];   {introduce retrospective for the FPSIF-theory}
376    I1p_neu:=(Uext(t)-R1*I1_alt-L12*I2p_alt)/L11;  { directely the solution of the differential-equation }
376a   I1p_neu:=(Uext(t)-R1*I1_alt-L12*I2p_alt-Q1/C1)/L11;    {directly the solution of the differential-equation}
377    I2p_neu:=(0-R2*I2_alt+L21*I1p_alt)/L22;        { directely the solution of the differential-equation }
377a   I2p_neu:=(0-R2*I2_alt+L21*I1p_alt-Q2/C2)/L22;          {directly the solution of the differential-equation}
378    I1_neu:=I1_alt+dt*I1p_neu;                  {directely the solution of the differential-equation}
379    I2_neu:=I2_alt+dt*I2p_neu;                  {directely the solution of the differential-equation}
380    I1p_rueck[0]:=I1p_neu;        {yoke-retrospective: allocate the last step}
381    I2p_rueck[0]:=I2p_neu;        {yoke-retrospective: allocate the last step}
381a   Q1:=Q1+I1_neu*dt;   Q2:=Q2+I2_neu*dt;   {Integration of the electrical charges inside the capacitors}
382    If Prozent_fertig and((I mod Round(Imax/65))=0) then Write('*');
383    {count together (i.e. integrate) the energy-balances:}
384    Ener_Uext:=Ener_Uext+Uext(t)*I1_neu*dt;   {Integral over “power*dt”: at the voltage source.}
385    Ener_R1:=Ener_R1+R1*I1_neu*I1_neu*dt;     {Integral over “power*dt”: in the primary circuit}
386    Ener_R2:=Ener_R2+R2*I2_neu*I2_neu*dt;     {Integral over “power*dt”: in the secondary circuit}
387    Ener_Sp1:=Ener_Sp1+RSp1*I1_neu*I1_neu*dt; {Ohmic Energy-losses in the wire of coil number 1}
388    Ener_V1:=Ener_V1+RV1*I1_neu*I1_neu*dt;   {Ohmic Energy-supply to consumer number 1}
389    Ener_Sp2:=Ener_Sp2+RSp2*I2_neu*I2_neu*dt; {Ohmic Energy-losses in the wire of coil numbe 2}
390    Ener_V2:=Ener_V2+RV2*I2_neu*I2_neu*dt;    {Ohmic Energy-supply to consumer number 2}
391    {If required by the user, we have to write the recorded data into the Excel-File:}
392    If (((I mod ExcelSteps)=0)and(Protokoll)) then
393    begin
394      Spaltenlaenge:=Spaltenlaenge+1;
395      Erg[ 1,Spaltenlaenge]:=I;
396      Erg[ 2,Spaltenlaenge]:=t;
397      Erg[ 3,Spaltenlaenge]:=Uext(t);
398      Erg[ 4,Spaltenlaenge]:=I1_neu;
399      Erg[ 5,Spaltenlaenge]:=I1p_neu;
400      Erg[ 6,Spaltenlaenge]:=I2_neu;
401      Erg[ 7,Spaltenlaenge]:=I2p_neu;
402      Erg[ 8,Spaltenlaenge]:=Uext(t)*I1_neu;
403      Erg[ 9,Spaltenlaenge]:= I2_neu*I2_neu*RV2;
404      Erg[10,Spaltenlaenge]:= I1_neu*I1_neu*RV1;
405      Erg[11,Spaltenlaenge]:=(Ener_Uext+Ener_R2)-Ener_R1;
405a     Erg[12,Spaltenlaenge]:=Q1;
405b     Erg[13,Spaltenlaenge]:=Q1/C1;
405c     Erg[14,Spaltenlaenge]:=Q2;
405d     Erg[15,Spaltenlaenge]:=Q2/C2;
406    end;
407    Until I>=Imax;
408    If Prozent_fertig then Writeln('');
409
410    {Integration-steps for the calculation of the energy-balances:}
411    Writeln(' '); Writeln('Evaluation of the results:');
412    Writeln('Ener_Uext = Uext*I1*dt = ',Ener_Uext:10:5,'Joule        COILS            CONSUMER');
413    Writeln('Ener_R1 = R1*I1^2*dt = ',Ener_R1:12:5,' J; Sp1 = ',Ener_Sp1:10:5,'J: Verb_1 = ',Ener_V1:10:5,'J');
414    Writeln('Ener_R2 = R2*I2^2*dt = ',Ener_R2:12:5,' J; Sp2 = ',Ener_Sp2:10:5,'J: Verb_2 = ',Ener_V2:10:5,'J');
415    Writeln('For comparison:  Ener_Uext + Ener_R2 = ',Ener_Uext+Ener_R2:12:5,' J');
416    Writeln('ctrl: (Ener_Uext+Ener_R2)-Ener_R1= ',(Ener_Uext+Ener_R2)-Ener_R1:15,' Uncertainty plus FPSIF-Energy-conversion');
417  { Writeln(' =>   COP   eta   = ',(Ener_R2/Ener_Uext*100):10:7,' %');} {The coefficient of performance (COP) does not yet make sense this way -> do not print it.}
418
419    {Excel-data-output to a data-record-file, if required by the user:}
420    Write('Excel-data-output ?  <Y|N> '); Read(Kieh); Writeln(Kieh);
421    If Kieh='y' then Kieh:='Y';
422    If Kieh='Y' then
423    begin
424      Spaltenzahl:=11; ExcelAusgabe('Test.xls');
424b     Spaltenzahl:=15; ExcelAusgabe('Test.xls');
425      If (Spaltenlaenge>=0) then Writeln('Length of the columns in Excel: ',Spaltenlaenge);
426      If (Spaltenlaenge<0) then Writeln('An Excel-data-protocol was not made.');
427      Writeln;  Wait; Wait; Wait;
428    end;
429  End.
```