

The Wuerth overunity rotator claim

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Abstract: A simple mechanical setup proposed and built by F. Wuerth is calculated acc. to theoretical mechanics. The calculation predicts no overunity behaviour for any cycle path because the mathematical description of the system fullfills Hamiltonian energy conservation. The experiments regarding the claims of Wuerth are discussed. If these experiments are performed as fall experiments no overunity can be found and the theory coincides with the experiment exactly. If these experiments are performed horizontally two independent references exist which claim that during the braking process no back torque can be measured.

1. Introduction

In a recent article [1] the author discussed parametric driven "perpetuum mobiles" which are in fact analogs to wind wheels in a wind field. The result was that for simple problems like a soft iron bowl in a permanent magnet field (Watson's SMOT) such effects are not possible due to the existing conservative force field. However, if the coupling constant varies with time overunity is possible in principle. At first sight the Wuerth parametric rotator presented here seems to be such a system as well, however it will be shown in this article, that this is not possible from the theory.

2. Experimental setup

Wuerth's experiments originate from Stein's rotor setup [2] which has been published to a bigger audience by the journalist G. Hielscher [3]. The description here is taken from [4] and [5], comp fig.1 a)-c). Further material can be found published at [6] -[9] .

Two cylindric rotors are mounted on both ends of a long slab . They can rotate freely around their perpendicular axis of symmetry in the horizontal plane. The slab itself rotates as well horizontally around a perpendicular axis which is exactly in the middle of the slab.

If the slab is set into rotation with the angular velocity $\dot{\phi}$ in fig.1a, the position of the rotation angle of the rotors $\dot{\alpha}$ remains the same relatively to the outstanding observer. Relatively to the observer in the rotating system of the slab the position angle rotates backwards with the angular velocity $\dot{\alpha} = -\dot{\phi}$. Due to friction the relative velocity $\dot{\alpha}$ backwards in the slab system looses its speed with time until the rotor moves in phase with the slab exactly like an rigid body. The Wuerth system proceeds a cycle consisting of three essential steps, comp. fig.1b).

ACCELERATION

1) During the acceleration the movement of the slab is coupled to the rotors by a (geared) belt. The ratio of the proceeded angles is chosen by the translation of the gears to be

$$\eta := \frac{\Delta\alpha}{\Delta\phi} \quad (1)$$

EQUALIZATION

2) If the angular velocity $\dot{\phi}_1$ is achieved, the relative velocity $\dot{\alpha}$ between slab and the rotating cylinder is brought to zero.

Two technical options exist to do that:

- * driving the rotors separately by belts from outside, comp. fig.1c.
- * decoupling the constraint between $\dot{\alpha}$ and $\dot{\phi}$ and using brakes.

DECELERATION

3) Then, the whole rigid system is decelerated.

It is claimed by O. Stein (2) and later by F. Wuerth, (3) that these cycles yield a net work gain.

3. Theoretical calculation

3.1 Cycles with driven rotors

The experimental setup are represented in fig. 1b) + 1c). The cycle is calculated as follows:

3.1.1 Acceleration

During the acceleration the system is subjected to the constraint

$$\eta := \frac{\dot{\alpha}}{\dot{\phi}} = \text{constant} \quad (2)$$

where $\dot{\alpha}$ is the angular velocity in the slab system and $\dot{\phi}$ is the angular velocity of the slab, comp. fig.2 . Acc. to the derivation in the appendix and using equation 2 the kinetic energy during the acceleration is

$$\hat{E}_{kin}^{acc} = \frac{1}{2}(\Theta_1 \dot{\phi}^2 + \Theta_2 (\dot{\phi} + \dot{\alpha})^2) = \frac{1}{2}(\Theta_1 + \Theta_2(1+\eta)^2) \dot{\phi}^2 \quad (3)$$

with $\Theta_1 = mr_0^2 + \Theta_{slab}$ being the inertia moment due to the centre of mass point rotation plus inertia of the slab . Θ_2 is the inertia moment of the rotor.

For more easy writing we use all energies, torques and angular momentas are divided by Θ_1 , meaning we change (3) to

$$E_{kin}^{acc} := \hat{E}_{kin}^{acc} / \Theta_1 = \frac{1}{2}(\dot{\phi}^2 + k(\dot{\phi} + \dot{\alpha})^2) = \frac{1}{2}(1 + k(1+\eta)^2) \dot{\phi}^2 \quad (4)$$

where we used the definition $k := \Theta_2 / \Theta_1$.

If we use the definition $V^{acc}(\varphi)$ for the potential energy (divided by Θ_1) of a motor or a spring, the total energy E_{tot}^{acc} is conserved during acceleration acc. to Hamiltonian mechanics.

$$\mathcal{H} = E_{tot}^{acc} = E_{kin}^{acc}(\dot{\varphi}) + V^{acc}(\varphi) = constant \quad (5)$$

The Lagrange energy \mathcal{L} is

$$\mathcal{L} = E_{kin}^{acc}(\dot{\varphi}) - V^{acc}(\varphi) \quad (6)$$

The angular moment L is

$$L = \frac{\partial \mathcal{L}}{\partial \dot{\varphi}} = (1 + k(1 + \eta)^2) \dot{\varphi} \quad (7)$$

Because $E_{tot}^{acc} = constant$ or $\Delta E_{tot}^{acc} = 0$ during acceleration

$$\Delta E_{kin}^{acc}(\dot{\varphi}_1) = -\Delta V^{acc} \quad (8)$$

holds as well where $\dot{\varphi}_1$ is the final angular velocity of acceleration .

3.1.2 Equalization driving the rotors

To be sure we will apply two calculation procedures in order to calculate the cycle. These are the Lagrange equations of first and second kind, comp. [10] p.87-88 and p.38 ff. . The Noether theorem, comp. [10] Kap.5, will be applied as well to check the results independently.

Derivation using the Lagrange equation of second kind

The receipt of the Lagrange formalism of 2nd kind is as follows:

- * write down the Lagrange energy in terms of all independent generalized coordinates
- * insert the constraints
- * calculate the Euler-Lagrange equations, i.e. the equations of motion
- * solve the equations of motion

The Lagrange energy of the whole setup is

$$\mathcal{L} = \frac{1}{2} \dot{\varphi}^2 + \frac{1}{2} k \dot{\gamma}^2 - V_{\varphi} - V_{\gamma} \quad (9)$$

Here is γ the angle position of the rotor. V_{φ} and V_{γ} are the "motor potentials" acting on rotor and slab. Because the coordinate γ above is not useful for the comparison with the experimental reality we apply a transformation for the coordinate γ

$$\gamma = (1 + \eta)\varphi - \eta\delta \quad (10)$$

Equation (10) inserted in eq.(9) yields the Lagrange energy in the generalized coordinates φ and δ

$$\mathcal{L} = \frac{1}{2}\dot{\varphi}^2 + \frac{1}{2}k[(1 + \eta)\dot{\varphi} - \eta\dot{\delta}]^2 - V_\delta(\delta) - V_\varphi(\varphi) \quad (11)$$

The torques (divided by Θ_1) on the axes $T_\delta = -\partial V/\partial\delta$ and $T_\varphi = -\partial V/\partial\varphi$ can be found from of the Euler-Lagrange equations derived from (11)

$$\begin{aligned} T_\delta &= k\delta\ddot{\eta}^2 - \eta k(1 + \eta)\ddot{\varphi} \\ T_\varphi &= [1 + k(1 + \eta)^2]\ddot{\varphi} - k(1 + \eta)\eta\ddot{\delta} \end{aligned} \quad (12)$$

If the φ -axis has no motor drive, i.e. $V_\varphi = \text{constant}$ or $T_\varphi = 0$, the second equation describes a conservation law of angular momentum which can be confirmed as well by application of the Noether theorem, comp. [10] Kap.5. If the equilization takes place without motor we have

$$[1 + k(1 + \eta)^2]\ddot{\varphi} = k(1 + \eta)\eta\ddot{\delta} \quad (13)$$

Integration of both sides yields for a equalization process

$$[1 + k(1 + \eta)^2](\dot{\varphi}_2 - \dot{\varphi}_1) = k(1 + \eta)\eta\dot{\varphi}_2 \quad (14)$$

Therefrom follows

$$\dot{\varphi}_2 = \dot{\varphi}_1 [1 + k(1 + \eta)^2] / [1 + k(1 + \eta)] \quad (15)$$

This formula describes the change of the rotation velocity of the slab during equilization if the motor of the axis is decoupled.

Derivation using the Lagrange equation of first kind

The receipt of calculation is as follows:

- * write down all present constraints
- * write down the Lagrange energy dependent from the maximum independent 6N generalized

coordinates (due to rotation and translation) of the N bodies of the system

* calculate the Euler-Lagrange equation including the Lagrange multiplier or constraint forces

* eliminate the Lagrange multiplier from the obtained equations.

* insert the constraints and solve the system of equations

This procedure has the advantage that all constraint forces can be seen in the calculation. The general formulation of the equation of motion is

$$\frac{d}{dt} \frac{\partial \mathcal{L}}{\partial \dot{q}_i} - \frac{\partial \mathcal{L}}{\partial q_i} = \sum_{i=1}^k \lambda_j a_{ij} = Z_{q_i} \quad (16)$$

where λ_j are Lagrange multiplier to be eliminated in the calculation, if necessary. The a_{ij} are the coefficients of the k constraints

$$\sum_{i=1}^{6N} a_{ij} dq_i + a_{0j} dt = 0 \quad j = 1, \dots, k \quad (17)$$

here written in differential form.

The Lagrange energy in generalized coordinates is

$$\mathcal{L} = \frac{1}{2} \dot{\varphi}^2 + \frac{1}{2} k [(1+\eta) \dot{\varphi} - \eta \dot{\delta}]^2 \quad (18)$$

Additionally we have the rheonomic constraints representing the motors

$$\begin{aligned} \varphi - \varphi(t) &= 0 \\ \delta - \delta(t) &= 0 \end{aligned} \quad (19)$$

which describe how rotor and slab are accelerated. It is not necessary to specify them more here because they drop out as we will see in the course of the calculation.

The Lagrange equations of 1st kind are in this case

$$\begin{aligned} \frac{d}{dt} \frac{\partial \mathcal{L}}{\partial \dot{\varphi}} - \frac{\partial \mathcal{L}}{\partial \varphi} &= [1 + k(1+\eta)^2] \ddot{\varphi} - k(1+\eta) \eta \ddot{\delta} = Z_{\varphi} \\ \frac{d}{dt} \frac{\partial \mathcal{L}}{\partial \dot{\delta}} - \frac{\partial \mathcal{L}}{\partial \delta} &= k \delta \ddot{\eta} - \eta k(1+\eta) \ddot{\varphi} = Z_{\delta} \end{aligned} \quad (20)$$

where $Z_{\varphi/\delta}$ are the constraint forces of the motors.

Both equation are already known from equation (12), because we can identify $T_{\varphi/\delta} = Z_{\varphi/\delta}$.

Acc. to the last two sections the energy to achieve the equilization can be calculated. If the rotor is equilized at $\dot{\phi}_1 = \text{constant}$ then the exchanged energies are:

$$E_{\delta} = \int Z_{\delta} d\delta = \int_0^{\dot{\phi}_1} \eta^2 k \ddot{\delta} \dot{\delta} dt = \frac{1}{2} \eta^2 k \dot{\phi}_1^2 \quad (21)$$

$$E_{\varphi} = \int Z_{\varphi} d\varphi = - \int_0^{\dot{\phi}_1} \eta(1+\eta) k \ddot{\phi}_1 \dot{\phi}_1 dt = -\eta(1+\eta) k \dot{\phi}_1^2$$

In sum we have

$$\Delta E_2 = E_{\gamma} + E_{\varphi} = -\eta(1+0.5\eta) k \dot{\phi}_1^2 \quad (22)$$

3.1.3 Deceleration

During the deceleration the system is rigid. The kinetic energy during the deceleration can be calculated acc. to the Steiner formula as

$$E_{kin}^{dec} = \frac{1}{2} (1+k) \dot{\phi}^2 \quad (23)$$

The angular moment is

$$L^{dec} = (1+k) \dot{\phi} \quad (24)$$

If we use the definition $V^{dec}(\varphi)$ for the potential energy stored up by a generator or a spring, the total energy E_{tot}^{dec} is

$$\mathcal{H} = E_{tot}^{dec} = E_{kin}^{dec}(\dot{\phi}) + V^{dec}(\varphi) = \text{constant} \quad (25)$$

is conserved during deceleration acc. to Hamiltonian mechanics.

Because $E_{tot}^{dec} = \text{constant}$ or $\Delta E_{tot}^{dec} = 0$ during acceleration holds as well

$$\Delta E_{kin}^{dec}(\dot{\phi}) = -\Delta V^{dec} \quad (26)$$

3.1.4 The energy balance of closed cycles with driven rotors

Cycle 1: during the equilization phase the angular velocity of the slab is held constant.

The performance of the cycle is described in the tabel below:

	<u>rotor</u>		<u>slab</u>	
acceleration:	$\dot{\delta} = 0$,	$\dot{\varphi} = 0$	$\rightarrow \dot{\varphi} = \dot{\varphi}_1$
equalization:	$\dot{\delta} = 0 \rightarrow \dot{\delta} = \dot{\varphi}_1$,	$\dot{\varphi} = \dot{\varphi}_1$	
deceleration:	$\dot{\delta} = \dot{\varphi}_1 \rightarrow \dot{\delta} = 0$,	$\dot{\varphi} = \dot{\varphi}_1 \rightarrow \dot{\varphi} = 0$	

energy balance:

$$\text{acceleration: } \Delta E_1 = \frac{1}{2}(1 + k(1 + \eta)^2) \dot{\varphi}_1^2 \quad \text{eq.(4)}$$

$$\text{equalization: } \Delta E_2 = -\eta(1 + 0.5\eta)k\dot{\varphi}_1^2 \quad \text{eq.(22)}$$

$$\text{deceleration: } \Delta E_3 = -\frac{1}{2}(1 + k) \dot{\varphi}_1^2 \quad \text{eq.(23)}$$

$$\text{sum: } \Delta E_1 + \Delta E_2 + \Delta E_3 = 0$$

Cycle 2: during the equilization the slab is decoupled from the motor.

The performance of the cycle is described in the tabel below:

	<u>rotor</u>		<u>slab</u>	
acceleration:	$\dot{\delta} = 0$,	$\dot{\varphi} = 0$	$\rightarrow \dot{\varphi} = \dot{\varphi}_1$
equalization:	$\dot{\delta} = 0 \rightarrow \dot{\delta} = \dot{\varphi}_2$,	$\dot{\varphi} = \dot{\varphi}_1$	$\rightarrow \dot{\varphi} = \dot{\varphi}_2$
deceleration:	$\dot{\delta} = \dot{\varphi}_2 \rightarrow \dot{\delta} = 0$,	$\dot{\varphi} = \dot{\varphi}_2$	$\rightarrow \dot{\varphi} = 0$

energy balance:

$$\text{acceleration: } \Delta E_1 = \frac{1}{2}(1 + k(1 + \eta)^2) \dot{\varphi}_1^2 \quad \text{eq.(4)}$$

$$\text{equalization: } \Delta E_2 = \frac{1}{2}k\dot{\varphi}_2^2 \quad \text{eq.(21)}$$

$$\text{deceleration: } \Delta E_3 = -\frac{1}{2}(1 + k) \dot{\varphi}_2^2 \quad \text{eq.(23)}$$

$$\text{sum: } \Delta E_1 + \Delta E_2 + \Delta E_3 = 0$$

The balance can be proved using the relation between $\dot{\varphi}_1$ and $\dot{\varphi}_2$ eq. (15).

3.2. Cycles with braked rotors

Cycle 1: braking with motor decoupled from φ - driving motor

3.2.A1 Acceleration

The energy to apply in the acceleration phase is the same as calculated in section 3.1.1, i.e.

$$\Delta E_{kin}^{acc} = \frac{1}{2}(1 + (1+\eta)^2 k) \dot{\varphi}_1^2 \quad (27)$$

3.2.A2 Braking the rotor with motor decoupled from φ - driving motor

During the braking the rotors move freely because the whole setup is totally decoupled from any driving axis and exchanges no energy with the motors. We have the task to calculate the angular velocity of the slab $\dot{\varphi}_2$ after braking.

We use the Lagrange formalism of 2nd kind including friction, comp.[10] p.38 ff..

The receipt of this procedure is as follows:

- * write down the Lagrange energy in terms of all independent coordinates
- * insert the constraints
- * calculate the Euler-Lagrange equations, i.e. the equations of motion
- * solve the equations of motion

The Lagrange energy \mathcal{L} is

$$\mathcal{L} = \frac{1}{2}\dot{\varphi}^2 + \frac{1}{2}k\dot{\gamma}^2 = \frac{1}{2}\dot{\varphi}^2 + \frac{1}{2}k(\dot{\varphi} + \dot{\alpha})^2 \quad (28)$$

with $\gamma := \varphi + \alpha$ as rotational and φ as translational coordinate. We chose as independent coordinates φ and α . The dissipation function is

$$P = \frac{1}{2}k^* \dot{\alpha}^2 \quad (29)$$

where we defined k^* as the friction constant divided by Θ_1 . The general formulation of the equation of motion is

$$\frac{d}{dt} \frac{\partial \mathcal{L}}{\partial \dot{q}_i} - \frac{\partial \mathcal{L}}{\partial q_i} + \frac{\partial P}{\partial \dot{q}_i} = 0 \quad (30)$$

where the generalized coordinates q_i are α and φ in our case. The force terms $\partial \mathcal{L} / \partial q_i$ are zero, because no forces act on the system from outside. Therefrom, the equations of motion can be derived to

$$\begin{aligned}\ddot{\phi} + k(\ddot{\phi} + \ddot{\alpha}) &= 0 \\ k^* \dot{\alpha} + k(\dot{\phi} + \dot{\alpha}) &= 0\end{aligned}\tag{31}$$

If we subtract both equations (31) we get

$$\ddot{\phi} = k^* \dot{\alpha}\tag{32}$$

This equation is reinserted into the second equation (31) . Therefrom, we get the equation of motion for α

$$\ddot{\alpha} + k^* \left(1 + \frac{1}{k} \right) \dot{\alpha} = 0\tag{33}$$

Therefrom, with the initial condition $\alpha(t=0) = \eta \dot{\phi}_1$ and using the definition $\tau = 1/[k^*(1 + 1/k)]$ the solution follows as

$$\dot{\alpha}(t) = \eta \dot{\phi}_1 \exp(-t/\tau)\tag{34}$$

If we integrate (32) from $t=0$ to ∞ using (34) we get

$$\dot{\phi}_2 - \dot{\phi}_1 = \eta \dot{\phi}_1 / [(1 + 1/k)]\tag{35}$$

This result can be obtained as well using the assumption that the total angular momentum $L_{tot} = \dot{\phi} + k(\dot{\phi} + \dot{\alpha})$ (derived in the appendix) is conserved during the braking process, i.e.

$$\dot{\phi}_1 + k(1 + \eta)\dot{\phi}_1 = (1 + k)\dot{\phi}_2\tag{36}$$

This equation is equivalent to equation (35).

3.2.A3 Deceleration

The energy obtained in the deceleration phase is principally the same as calculated in section 3.1.3

$$\Delta E_{kin}^{dec} = \frac{1}{2}(1 + k)\dot{\phi}_2^2\tag{37}$$

3.2.A4 Energy balance

With the information of this section 3.2.A we can establish the total energy balance of this cycle. Using (27),(36) and (37) we obtain

$$\begin{aligned}
+\Delta E_{kin}^{acc} &: +\frac{1}{2}(1+(1+\eta)^2k)\dot{\phi}_1^2 \\
+\Delta E_{kin}^{rotor} &: 0 \\
+\Delta E_{kin}^{dec} &: -\frac{1}{2}(1+k)\left(1+\frac{2\eta k}{1+k}+\frac{\eta^2 k^2}{(1+k)^2}\right)\dot{\phi}_1^2 \\
\hline
\oint dE_{kin} &:= +\frac{1}{2}k\eta^2\left(1-\frac{k}{1+k}\right)\dot{\phi}_1^2
\end{aligned} \tag{38}$$

Because $\oint dE_{kin}$ is always positive the end result is a energy loss .

Cycle B: braking with motor coupled to ϕ - driving motor ($\dot{\phi}_1 = \dot{\phi}_2 = constant$)

3.2.B1 Acceleration

The energy to apply in the acceleration phase is the same as calculated in section 3.1.1, i.e.

$$\Delta E_{kin}^{acc} = \frac{1}{2}(1+(1+\eta)^2k)\dot{\phi}_1^2 \tag{39}$$

The acceleration work is represented by the lower line of the red area in the work diagram of kinetic energy, see fig. 3b .

3.2.B2 Braking the rotor

We use here the Lagrange formalism of 1nd kind including friction, comp.[10] p.87/88 ff. .

The general formulation of the equation of motion is here

$$\frac{d}{dt}\frac{\partial \mathcal{L}}{\partial \dot{q}_i} - \frac{\partial \mathcal{L}}{\partial q_i} + \frac{\partial P}{\partial \dot{q}_i} = \sum_{j=1}^k \lambda_j a_{ij} = Z_{q_i} \tag{40}$$

The Lagrange energy \mathcal{L} is

$$\mathcal{L} = \frac{1}{2}\dot{\phi}^2 + \frac{1}{2}k\dot{\gamma}^2 \tag{41}$$

with $\gamma := \phi + \alpha$ as rotational and ϕ as translational coordinate. The dissipation function is

$$P = \frac{1}{2} k^* (\dot{\gamma} - \dot{\varphi})^2 \quad (42)$$

Therefrom the equations of motion are derived to

$$\begin{aligned} \ddot{\varphi} - k^* (\dot{\gamma} - \dot{\varphi}) &= Z_\varphi \\ k^* (\dot{\gamma} - \dot{\varphi}) + k\dot{\gamma} &= Z_\gamma \end{aligned} \quad (43)$$

Inserting the only constraint $\varphi - \dot{\varphi}_1 t = 0$ with $\dot{\varphi}_1 = \text{constant}$ and using the definition $\gamma := \varphi + \alpha$ we get

$$\begin{aligned} Z_\alpha = Z_\varphi &= -k^* \dot{\alpha} \\ k^* \dot{\alpha} + k\ddot{\alpha} &= 0 \end{aligned} \quad (44)$$

The solution of the second equation is

$$\dot{\alpha} = \eta \dot{\varphi}_1 \exp(-t/\tau) \quad (45)$$

with $\tau := k/k^*$. The energy to brake down the relative movement of the rotor to the slab is (using (44))

$$E_{kin}^{brake} = - \int_0^\infty k^* \dot{\alpha} \cdot \dot{\varphi}_1 dt = \int_0^\infty k \ddot{\alpha} \dot{\varphi}_1 dt = -k\eta \dot{\varphi}_1^2 \quad (46)$$

where we used the definition $\dot{\alpha}_0 := \dot{\alpha}(t=0) = \eta \dot{\varphi}_1$ which is the angular velocity of the rotor during the braking.

3.2.B3 Deceleration

The energy obtained in the deceleration phase is again the same as calculated in section 3.1.3

$$\Delta E_{kin}^{dec} = \frac{1}{2} (1 + k) \dot{\varphi}_1^2 \quad (47)$$

3.2.B4 Energy balance

With the information from the last section we can establish the energy balance of a cycle:
It holds

$$\begin{aligned}
+\Delta E_{kin}^{acc} &: +\frac{1}{2}(1+(1+\eta)^2k)\dot{\phi}_1^2 \\
+\Delta E_{kin}^{rotor} &: -k\eta\dot{\phi}_1^2 \\
+\Delta E_{kin}^{dec} &: -\frac{1}{2}(1+k)\dot{\phi}_1^2
\end{aligned} \tag{48}$$

$$\oint dE_{kin} := +\frac{1}{2}k\eta^2\dot{\phi}_1^2$$

This means: we have a loss after a cycle.

4. Experiments

The author had the opportunity to see the setup used by Felix Wuerth, see fig.3. The setup presented by F. Wuerth contained only the blue and black swastika disk as rotors shown in fig.3.

The energy measurement are made using a torque meter. The angular velocity is measured by a tachometer coupled to the central axis. Power at the axis is calculated immediately from the interface card of the torque meter. Measured and calculated values are saved in arrays on a computer.

The torque meter couples to the central axis over a nut on which the key connector of instrument is set up. Acceleration and deceleration is made by hand using a crank lever. The rotation velocity is typically about 1 to 2 per second. Braking the rotors against the slab is done by strong Neodym-magnets which are fastened to the slab over a hinge. The hinges are turned down to the disks, attach and brake the rotor motion in about an second .

Fig.4a shows a run of a complete rigid setup with permanently braked rotors. It can be seen that after a run acceleration-deceleration a loss can be measured as expected from conventionally thinking.

Fig.4b shows a run: acceleration with freely moving rotors - braking the rotors by the magnets - deceleration with rotors braked.

The diagram shows a gain of about 10%. It should be mentioned that no deceleration of the slab could be observed by eye or by instrument during the braking phase contrary to the predictions of the theory.

Even if the first look on the plots fig.4a and fig.4b let arise some questions regarding the quality of the measurement, the data can be used perhaps as an first estimation because they are confirmed by independent observations [11].

The braking process of the four arms swastika-like rotor disks is done "automatically" with time during the movement. Probably this effect is less due to friction but due to the fact that the centre of mass of the disks is not the centre of the weight in the centrifugal force field for these rotating system. The swastika disk has four "centres of weight" which tend to go outwards as much possible and fix the position of the wheel in this way.

The author himself build up a falling disk experiment proposed in [11]. In principle this setup is Wuerth's setup with only one rotor disk using the gravitational field as motor and brake, comp. the exact documentation [12] and fig5a).

It could be confirmed that the movement of the rigid and the free moving disk is in full

agreement with the theory, comp fig 5b)+c).

If the falling free moving disk is braked down at the lowest point by a bolt locking the movement relatively to the slab, the movement slows down instantly and the the pendulum reaches only about half of the height, where it was started. Therefore, the experiment yields a loss, as expected by the theory presented in this article, but contrary to the hopes in [11].

Similarly, in order to test out special situations of movement of a mass, the author build up a "gliding perl" experiment comp. [13] and fig.6a: Here, a cylindric mass body with a hole along its axis slide could slide on a round stick filling the hole. The stick itself was fastened perpendicularly to an axis. This axis could be rotated as well.

In the experiment the stick with the body on it were set to a initial position which pointed almost perfectly against gravity. Then the stick was unlocked and the weight fell down to earth guided by the stick rotating around the axis.

This experiment as well was in agreement with the theory as shown in fig 6b) and c).

This means: both experiments performed by the author fulfilled the Hamiltonian energy conservation.

In order to see whether deviations to mechanics may appear in the horizontal plane the author built up a experiment proposed by Imris [18]. Imris states that an mass rotating around a centre wins energy if his path goes from a high to a narrow radius of rotation.

The own check of this claim [19] showed energy conservation acc. classical mechanics experimentally and theoretically and disproved Imris claims

5. Discussion

For the braked case the theory is in contradiction to the theory if we take all experiments for true. Acc. to the experiments [11] of Würth and Bucher it seems to be possible that rotors masses moving perpendicular to the gravity field violate the conservation of energy , However, acc. to the experiments of the author angular conservation and the theory is in accordance with experiments if the rotors move along the lines of the conservative gravity field and exchange energy with it.

This strange situation is augmented by experiments of Wuerth who claimed to have observed different moment of inertia for different sense of rotation at bodies which are far away from any symmetry and equilibration [9].

Therefore, the author played around with the idea that the third Newton's law is wrong and looked for correction terms which

- 1) are in accordance with Newton's first principle and do not selfaccelerate the system
- 2) allow to reproduce the macroscopic laws of planetary motion
- 3) allow to reproduce the abnormal effect during braking perpendicular to the field on the rotors
- 4) are compatible with all experiments reported above

Such correction term would apply only in certain forms of circular movement. For example, we can think on "magnetic-like" correction terms for $F = m \cdot a$ similar like $\Delta F \sim \vec{\omega} \times (\vec{r} \times \vec{g})$. These correction terms modify the centrifugal law.

In effect, the question, whether mechanics is good enough to describe all forms of mechanical movement should be clarified in the future. Therefore, it is planned to reproduce

the Wuerth's original experiment in the horizontal plane at the level reported here with an exact comparison between theory and experiment.

Nevermind, it can be interesting to collect messages of strange observations: Svein Utne reported the following experiment: If gyroscopes are accelerated to high rpm, then braked down, and reaccelerated, then the energy to speed them up again is significantly less [14,15]. The whole mechanical cycle is in some sense analogous to thermodynamic cycles, where the constraints of the path (isentrope, adiabate) are switched similarly like it is done in the cycle of the power booster. Here, we have a state space characterized by $E(\alpha, \dot{\alpha}, \varphi, \dot{\varphi})$ in thermodynamics we have the inner energy $U(S, V)$ or any other potential.

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Captions:

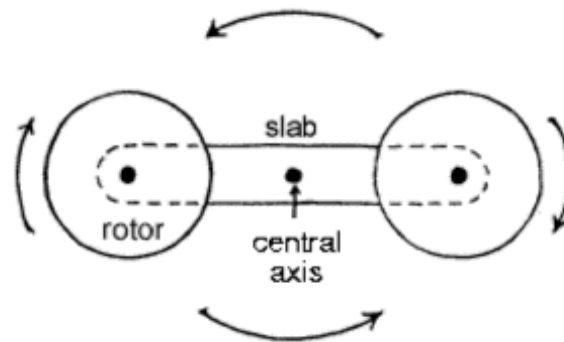


fig.1a: The Wuerth power booster: basic setup

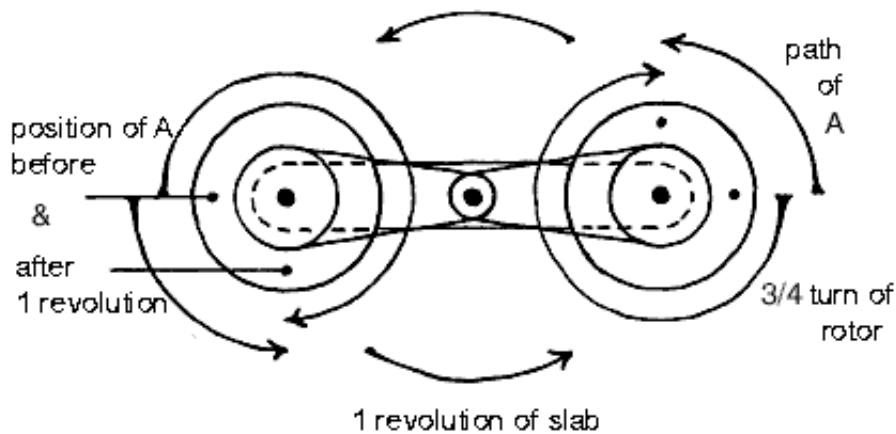


fig. 1b: The Wuerth power booster : here- implementation of the constraint of $= -3/4$

The working cycle consist of 3 phases:

1) Acceleration with constraint switched on

2) Equalization:

Case 1: Constraint mechanism decoupled

acceleration of the rotors separately from the RPM of the slab by rotating the central gears until they move in phase as a rigid body with the slab, comp. fig.3

Case 2: Constraint mechanism decoupled, braking at constant RPM of slab, or

3) Deceleration as rigid body and harnessing surplus energy

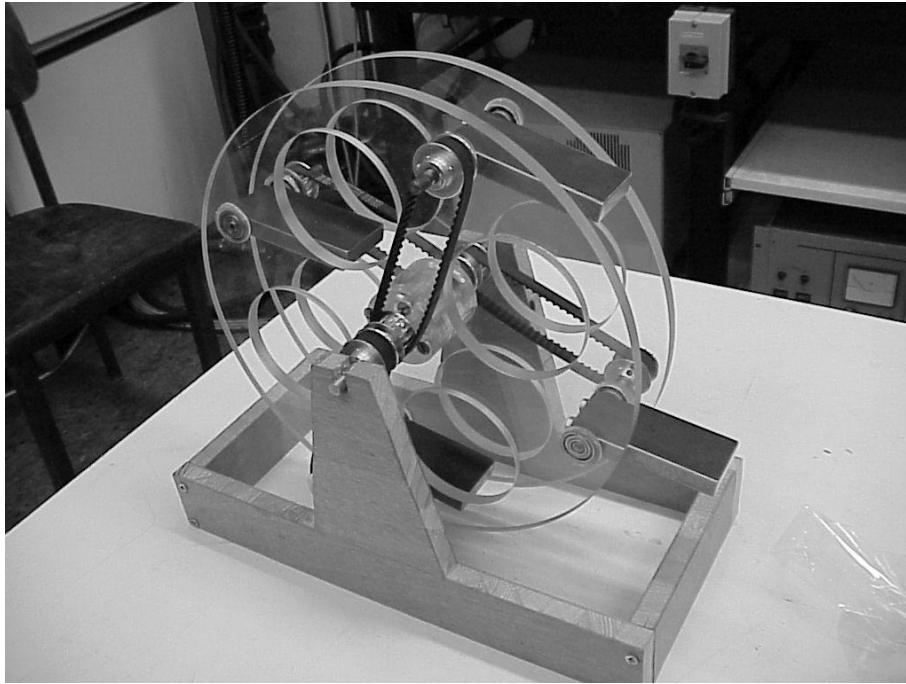


fig. 1c: A "perpetuum mobile flop" of the author illustrating here the belt drive mechanism of the rotors. The Plexiglas rotor corresponds to the slab. Its rotation angle is characterized by the φ -coordinate. It rotates around the central axis on a bearing. The central gear wheels are fixed to the central axis. The central axis can be rotated together with the rotors, as well. The rotation angle of the central axis is defined as δ . In the acceleration phase 1 the angle δ , meaning, the central axis is fixed. In phase 2 the angle velocity $\dot{\delta}$ is accelerated to $\dot{\delta}=\dot{\varphi}$. In phase 3 the whole rigid setup is decelerated to 0 as a rigid system.

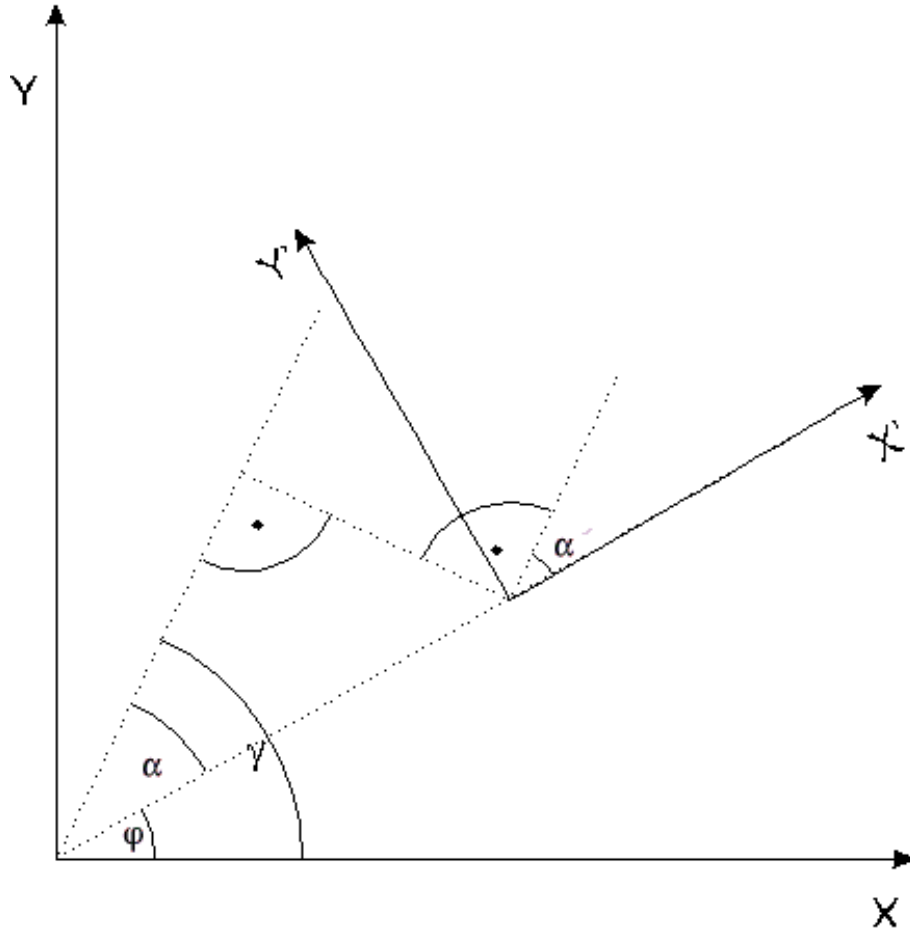


fig.2: The transformation of angles between a stationary observer and rotating coordinate system.



Fig.3: Wuerth's setup of the parametric rotator
During our measurements the belts were completely removed. The same holds for the red swastikas and the red parts inserted in the big disks.

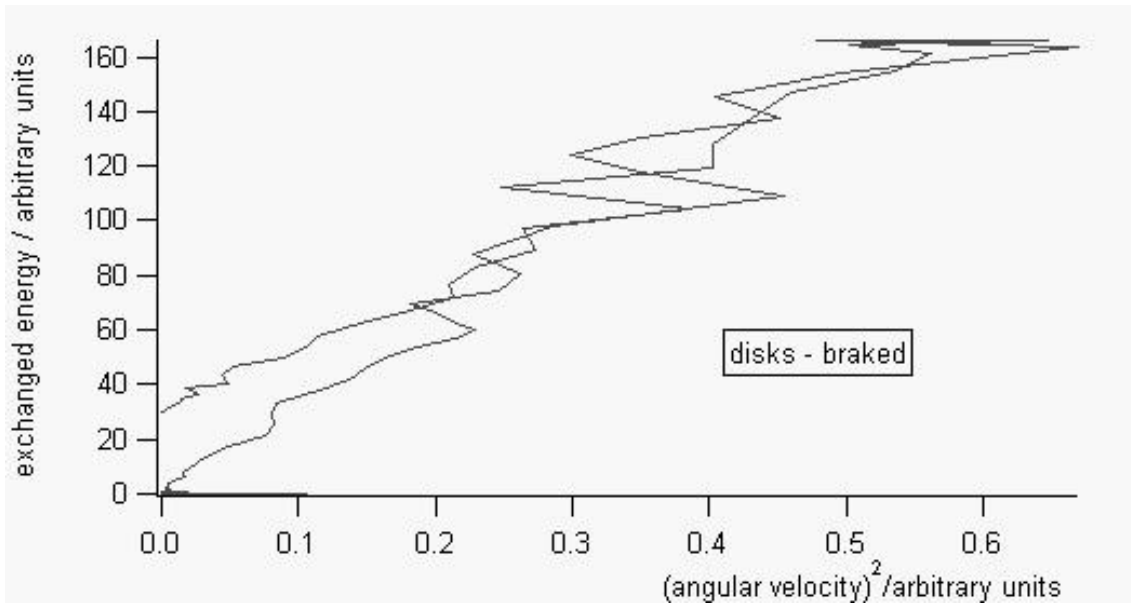


Fig.4a: Cycle with simplified setup of fig.5 ; exchanged mechanic energy vs. angular velocity acceleration and deceleration with braked rotors
 Starting point is at zero. A loss is measured as expected by conventional physics

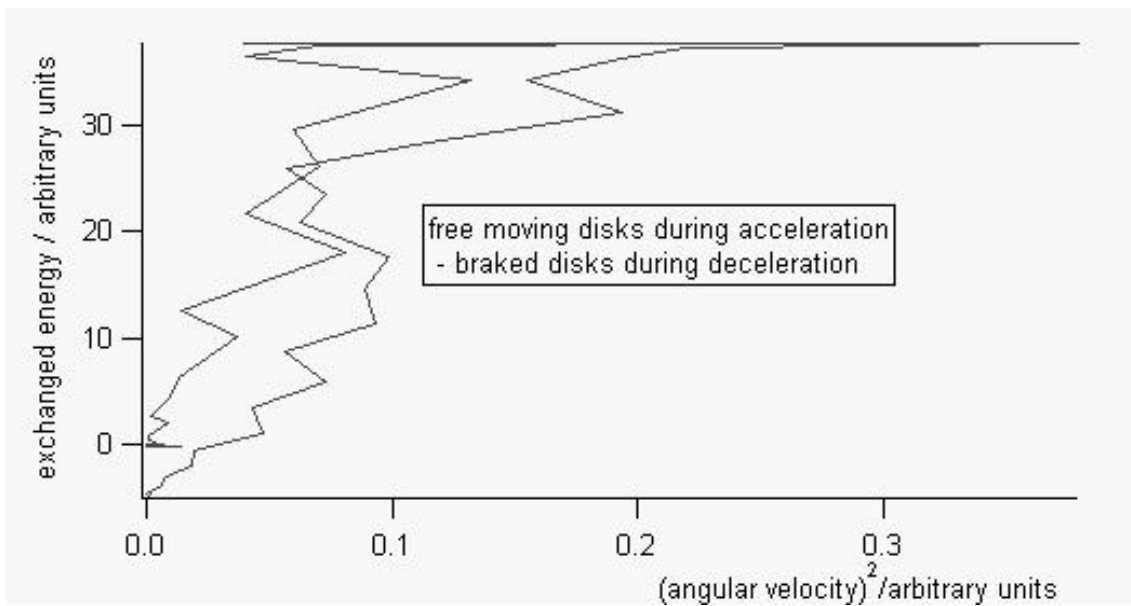


Fig.4b: Cycle with simplified setup of fig.5 ; exchanged mechanic energy vs. angular velocity
 Acceleration with free moving rotors
 Deceleration with braked rotors
 Starting point is at zero. A gain of about 10 % can be measured

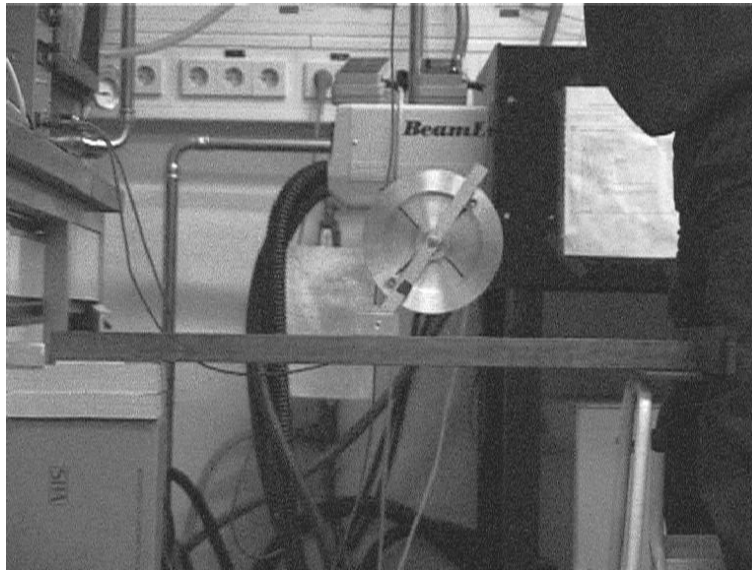


fig. 5a) the falling disk experiment

The metal disk + frame can rotate around the axis on the truss as a rigid body.

In the experiment the disk falls from the highest point to the lowest point.

The experiment is recorded by a video camera. From the video pictures the coordinates of the movement are recorded in aequidistant intervalls of the video frequency (25 Hz). The recording time of the half pictures is set to $1/1000$ sec.

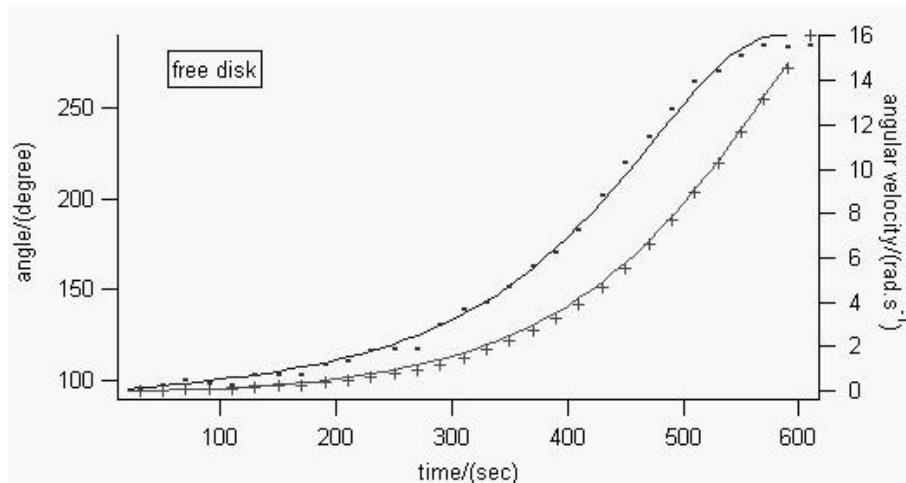


Fig.5b: angle and angular velocity vs. time for free movable disk in setup 7a)
 the disks starts at the top position and falls down
 angle vs. time are the red curves, the line are theoretical values, markers are experimental values, the scale is on the left;
 angular velocity vs. time are the blue curves, the line are theoretical values, dots are experimental values, the scale is on the right

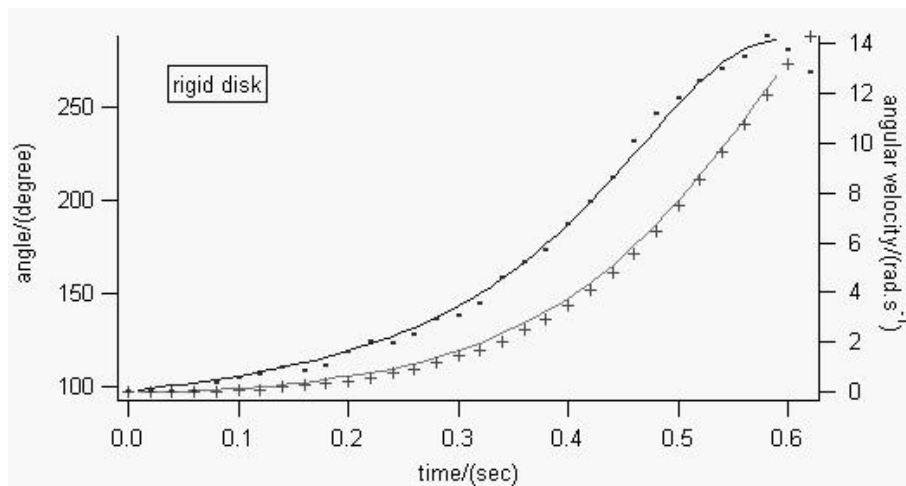


Fig.5c: angle and angular velocity vs. time for rigid non-movable disk in setup 7a)
 the disks starts at the top position and falls down
 angle vs. time are the red curves, the line are theoretical values, markers are experimental values, the scale on the left;
 angular velocity vs. time are the blue curves, the line are theoretical values, dots are experimental values, the scale is on the right

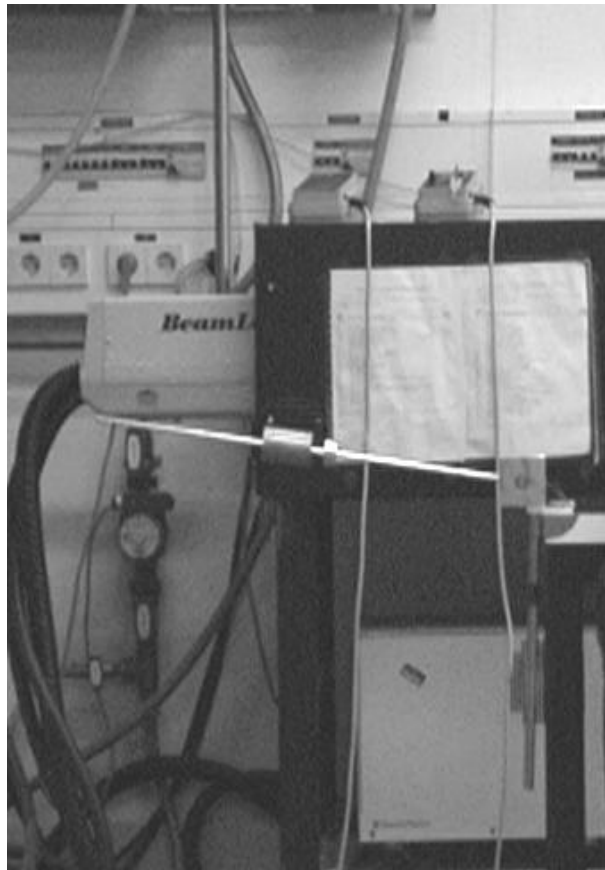


fig.6a: the "gliding pearl" experiment

The stick can rotate around the axis on the support.

In the experiment the stick with the pearl on it is started at the highest point and fall down to the lowest point. During this process the brass body moves outwards.

The experiment is recorded by a video camera. From the video pictures the coordinates of the movement are recorded in aequidistant intervalls of the video frequency (25 Hz). The recording time of the half pictures is set to 1/1000 sec.

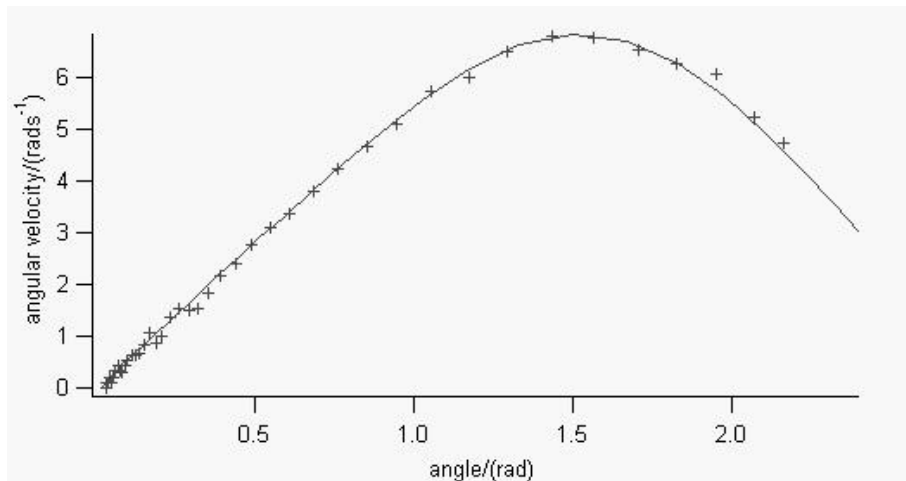


fig. 6b: "phase plane" angular velocity vs. angle of the gliding pearl experiment the line are theoretical values, markers represent experimental measurements

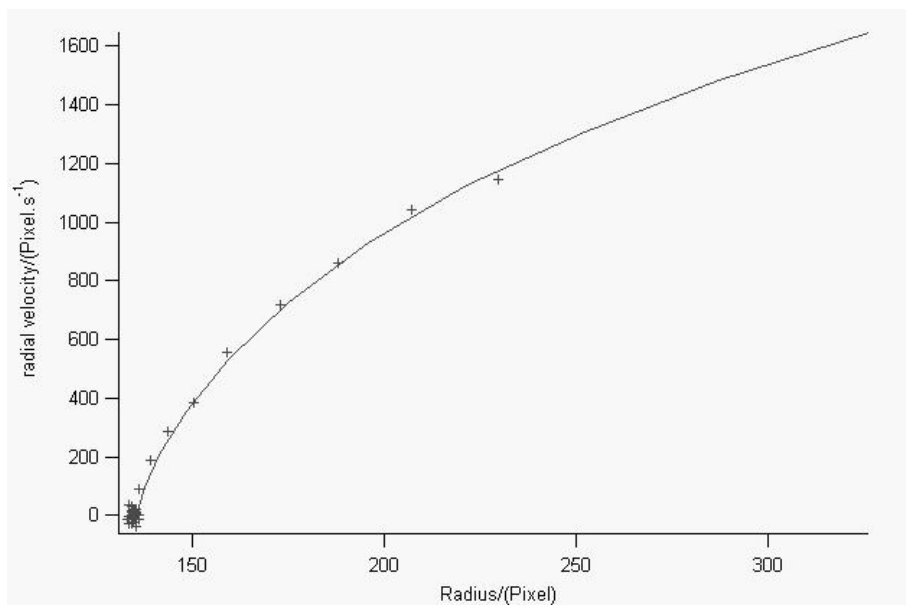


fig. 6c: "phase plane" radial velocity vs. radius of the gliding pearl experiment the line are theoretical values, markers represent experimental measurements



Fig 7a: The Imris experiment Phase 1 Alu frame (slab) and hammer weight (=asymmetric rotor) rotate in phase clockwise around the central (black) axis as "rigid" body

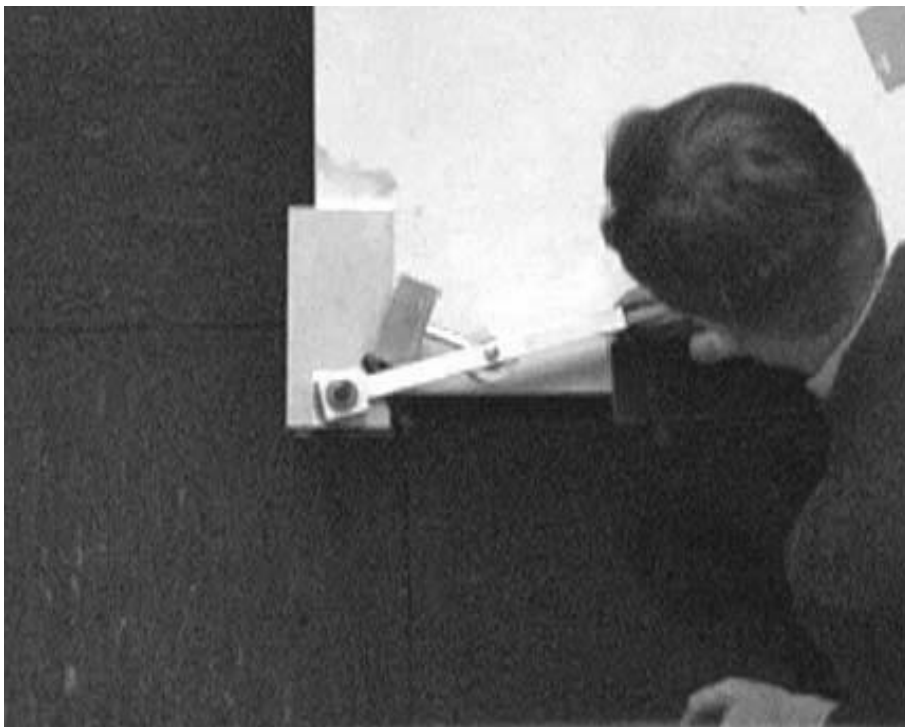


Fig.7b: the Imris experiment Phase 2 Alu frame (slab) has bounced against weight(on the left) and is stopped down. The hammer weight (=asymmetric rotor) continues to rotate at short radius.of rotation clockwise.

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