Energy Converter

The potential energy of 1 kg in 1 m must be as well as possible converted into the energy of a capacitor.
The energy is transformed by a dynamo.
Naturally the moving down has to be slow because otherwise a big part of the energy is at the end lost kinetic energy.

Best theoretical result

Potential energy: $W = m\,g\,h = 9{,}81\ J$
Energy of a capacitor: $W = ½\ CU^2 = 1/2\ QU$
the energy done in electric circuit is $W = QU$

Only 1/2 of the **Potential** Energy can be converted to energy of the capacitor

$$\rightarrow\ U = \sqrt{\frac{2 \bullet 1/2 \bullet W}{C}} = 313\ VV$$

Basis

The voltage produced by the dynamo has to increase, that's why a transformator is necessary.
The voltage becomes rectified by a Graetz-circuit. So you get a pulsating direct current with
$U(t) = |\ U_0 \sin \omega t\ |$

Model I

We think the amplitude of the voltage which is done on the capacitor as
$U_0 = 100\ V.$
$U(t) = |U_0 \sin \omega t\ |$
$U(t) = |U_0 \sin \omega t\ | = I\,R + U_C = I\,R + Q/C$
$I(t) = |U_0 \sin \omega t\ | - Q(t) / C$

$Q(t+dt) = Q(t) + I(t)\,dt$

$U_C = Q(t+dt) / C$

Now we made a simulation

Our results:
a little ω → big oscillations (FOLIE!)
a big R (resinstance) → longer duration up to the final result
→ smaller fluctuations (FOLIE!)

This experiment helps us to understand our result with the capacitor, because there it dures also a longer time to get the final result but there weren't neither many fluctuations.

Model 2

We think that the produced voltage is proportional to f and w = 2πf is. At this point we aren't looking at lost of energy in the capacitor.
W is getting bigger by w = alph*t. The maximum freqeuncy of turning left unchanged.
By variating alph the time t and so dt (we have 8000 iterations) has to be variated, too.
tmax = 100/ alph, dt = tmax /8000
By this you get always the same frequency.

Results

When alph is very high the capacitor doesn't become totally charged because the voltages are too high and the charging isn't as fast.

We can see that the voltage becomes higher by a linear increase.

(FOLIE!)
We also measured the increase of the voltage at the capacitor and also get this increase.
Without the capacitor the increase is much faster und the voltage becomes stable at the end.

Experiments

1. **We used the dynamo with mass but without the transformator and the capacitor:**

The alternating voltage is increasing in the first time but becomes stable later.

FOLIE!

2. **We measured the primary voltage with connected tranformator and capacitor.**
   Now the primary voltage is much lower. And it doesn't become stable!

   FOLIE!

Balance of power

The power of the falling body:
mgv

is split into:

- **warmth in the resistance R_1** : $I_1^2 R_1$
- **warmth in the resistance R_2** : $I_2^2 R_2$
- **mechanical capacity for acceleration of the rotating body** : $J \omega \alpha$
- **electrical capacity** : $1/C \; Q \, I$

$$\rightarrow \quad mg\,v = I_1^2 R_1 + I_2^2 R_2 + 1/C\, Q\, I_2 + J \omega \alpha$$

resistance R_1 : resistance of the dynamo: 2,2 Ω
resistance of the coil : 0,8 Ω
= 3 Ω

resistance R_2 : resistance of the coil : 3560 Ω

<u>We measured the currents on the primary and on the secondary side</u>

current I_1 : 0,7 A
current I_2 : 0,007 A

The size of the voltage isn't depending on the frequency of rotation but the time of period does depending.

Average:

I_1^2 R_1 = $(0{,}7A)^2/1{,}41$ 3 Ω = 1,04 W **(1,41 is the effective value of the current)**

I_2^2 R_2 = $(0{,}007\ A)^2$ / 1,41 3560 Ω =0,124 W

for Q/C = 100 V:

1/C Q I_2 = 100V 0,007 A = 0,7 W

Other possibilities

Piezoelectrical effect:

Problems:

- **very high voltages**
- **only short duration**
- **not possible to charge the capacitor**

MDH:

magneto-hydrodynamical-generator

Problems:

- **only possible for capacitors which are much smaller**