Free-Electron Pump (FEP) Experiments

1 Introduction

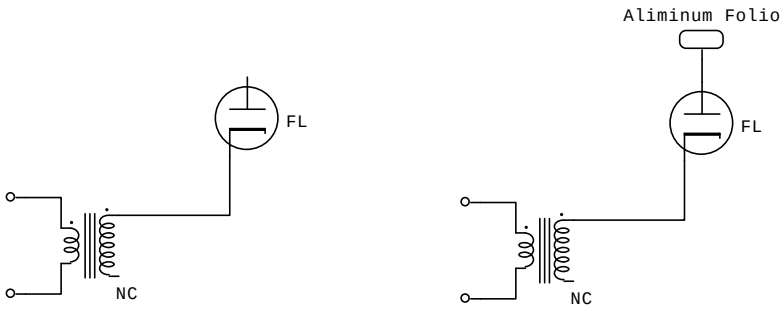


Fig. 1. FEP experiments, (a) one end of a Fluorescent lamp is open, (b) open end is connected to a large aliminium foil.

A simple two-transistor inverter circuit has been built for this experiment. The transformer shown in Fig. 1 is the inverter transformer. The inverter output voltage is in the form of pulses with an estimated peak value of about 700V. When a Fluorescent lamp is connected as shown in Fig. 1(a), the lamp is quite dim. When I place an aluminum foil on top of the lamp, it lits brighter (though not as bright as when it's connected to the transformer's secondary). How this happens?

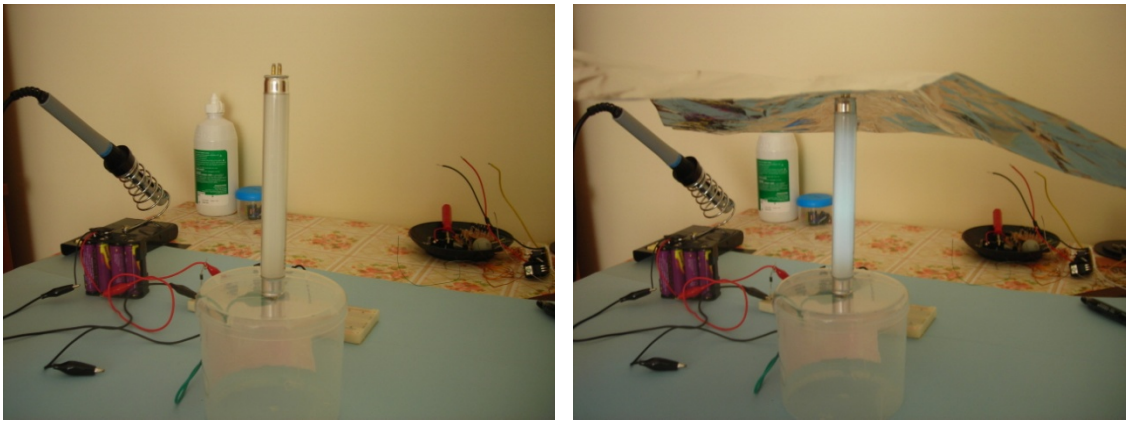


Fig. 2. FEP experiments.

The high voltage terminal which is connected to the Fluorescent lamp ionizes the gas inside the tube. As more electrons are released from the gas molecules (or atoms), it becomes more conductive. This in turn shorts the HV connected terminal of the FL lamp to the open terminal with minimal resistance. And the open terminal now has the same high potential. When I attach a large aluminum foil, it too is charged to this potential due to conductive path formed by the ionized gas. And the high potential causes more free electrons to be sucked from the aluminum foil by the transformer secondary which acts like a sink.

Therefore, additional electrons from the gas medium, and the aluminum foil are supplied, and in turn the lamp gets brighter. Larger metallic sheets will supply even more electrons. The secondary HV terminal acts as a sink, which generates the + potential and sucks the electrons. The moving electrons due to high potential are released by the - terminal of the secondary.

2 FEP Experiments

I built an oscillator based on 555 IC and drove an auto ignition coil using a BUZ30A-type SIPMOS transistor. The circuit can be seen in Fig. 3. I conducted some tests using the above circuit. Results are summarized in Tables 1 and 2.

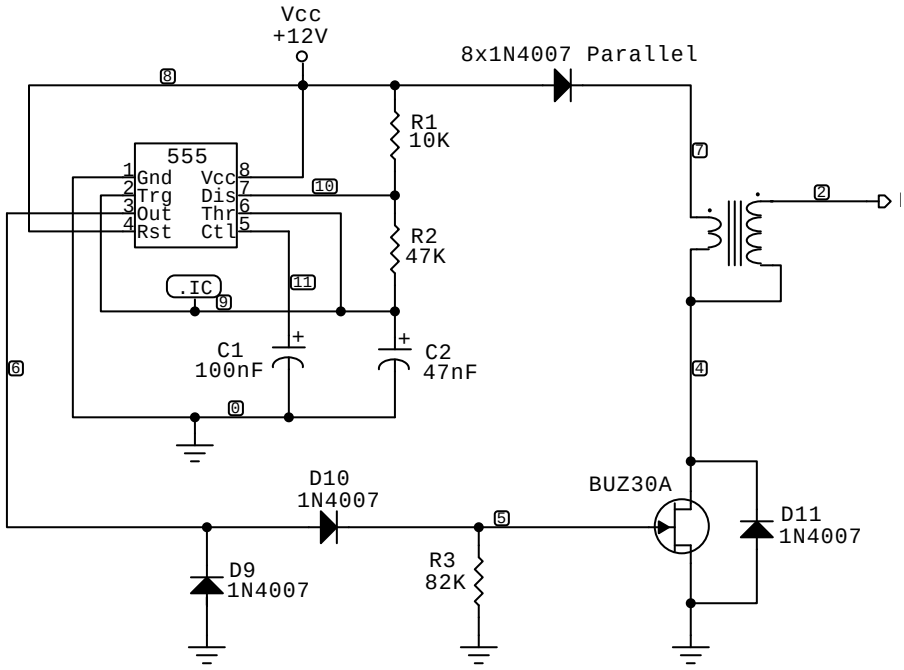


Fig. 3. The circuit.

Table 1. Tests with a modified computer PSU. R1=1K, R2=47K, C2=47nF.

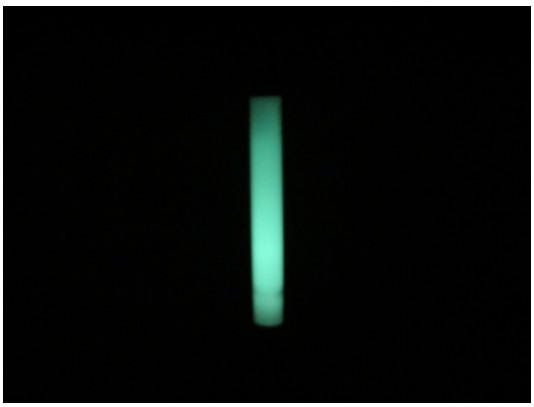
Case	VDC (V) @ IDC (A)	Power (W)
No foil	12V @ 1.22	14.64
Small foil (10x10 cm²)	12V @ 1.23	14.76
Medium foil (20x20 cm²)	12V @ 1.24	14.88
Large foil (30x29.6 cm²)	12V @ 1.25	15
Very large foil (51x55 cm²) (Taped to the wall)	12V @ 0.92	11.04
HV terminal is in a plastic container full with tap water	12V @ 1.25	15
20x20 cm² foil has been immersed in tap water	12V @ 1.25	15
HV wire is touching the desk	12V @ 1.23	14.76

Table 2. Tests with a modified computer PSU. R1=10K, R2=47K, C2=47nF.

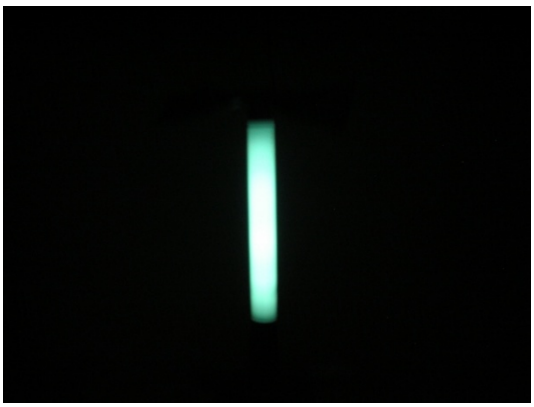
Case	VDC (V) @ IDC (A)	Power (W)
No foil	12V @ 1.34	16.08
Small foil (10x10 cm²)	12V @ 1.34	16.08
Medium foil (20x20 cm²)	12V @ 1.34	16.08
Large foil (30x29.6 cm²)	12V @ 1.34	16.08
Very large foil (51x55 cm²) (Taped to the wall)	12V @ 1.01	12.12
HV terminal is in a plastic container full with tap water	12V @ 1.33	15.96
20x20 cm² foil has been immersed in tap water	12V @ 1.33	15.96
HV wire is touching the desk	12V @ 1.33	15.96

Both tests indicate that by placing an aluminum foil on the Fluorescent lamp, the supplied DC power was about the same, except for the case of a very large aluminum foil taped to the wall. The supplied DC power is also dependent on oscillator frequency and duty cycle. Higher frequencies yield lower DC power consumption. It's possible to fine tune the system so that for a minimum supply power, maximum brightness can be obtained. As the size of the foil increases, the brightness of the Fluorescent lamp increases, which is shown in Fig. 4. For the case of very large foil taped to wall, the DC power dropped by at least 3.5 W for both tests, and the brightness increased significantly.

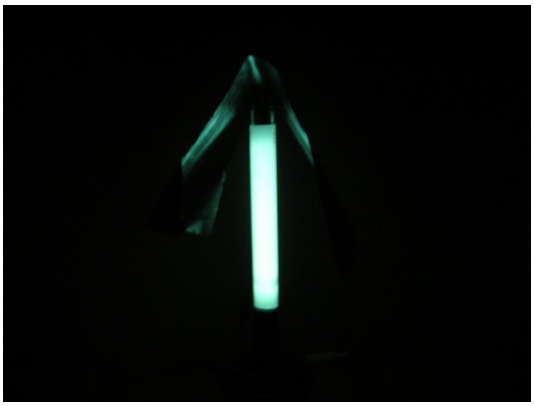
I immersed the medium foil in a plastic container that is half-full with tap water, and observed that FL lamp has about the same brightness when the medium foil is used alone. And the circuit consumed about the the same DC power. Then, I removed the foil and put the HV lead directly into the water. Nothing was changed. When I draw a spark from the aluminum foil, I notice that the spark is no longer blue. But it has a pink-purple color reminding an arc. And at sharp edges of the foil, the intensity of the arc was more. An arc indicates a high current density. Additional electrons sucked by the system must be the reason for this arc.



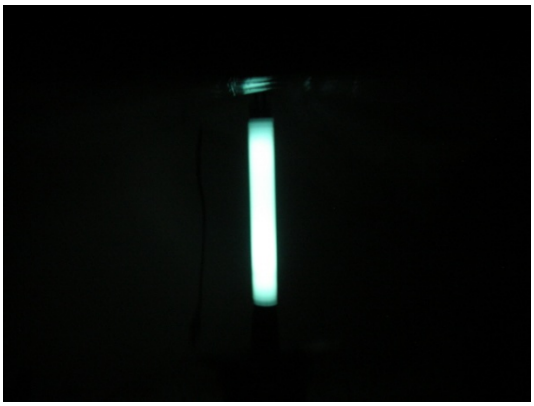
(a) No foil.



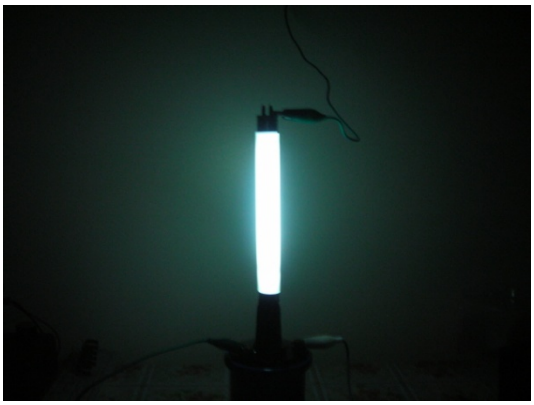
(b) Small foil (10x10 cm²).



(c) Medium foil (20x20 cm²).



(d) Large foil (30x29.6 cm²).



(e) Very large foil taped to the wall (51x55 cm^2).

Fig. 4. When the Fluorescent lamp is connected from just one end, it lits just a little. When a small piece of aliminium foil is placed on top, it lits brighter. As the size of aliminium foil becomes larger, the lamp gets brighter and brighter.

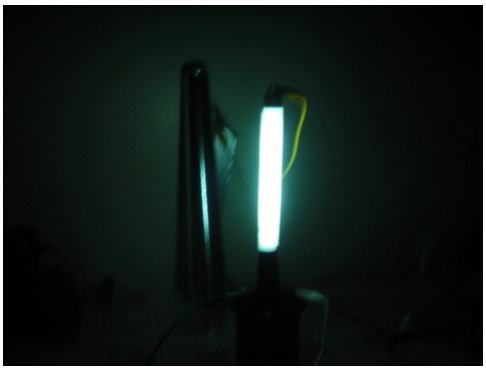


Fig. 5. When I connect the other end of the lamp to an aluminum foil roll, it lits as bright as when the very large foil is used. However, the circuit is noisier, as if the rushing waters. This may be due to mechanical vibration of the aliminium layers under high potential (since all layers have the same high potential that they repel each other).

3 Conclusions

Several Fluorescent lamps can be turned ON using an input power of several watts supplied by a 12V battery. The battery can be recharged from a solar panel. Such an equipment will lower the cost of lighting a lot, and it's especially great as main or backup light for homes, factories, campers, travelers, and boat owners. Lamps can be connected in parallel. One end of a

lamp is capacitively connected to the HV terminal and the other end is connected to aluminum foil.

For questions or comments:

4beowulf7@gmail.com