The effect of low and high pressure on electric current in a gas

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This paper describes the construction of simple equipment for demonstrating the effect of low and high pressure on electric current in a gas.

Electric current in a gas at low pressure

Tools: A glass tube of inner diameter 3-4 mm, about 30 cm long, with a drain on its side; two wires with a crocodile clip on one side and a sealing lid with metal electrode on the other side; 60 ml syringe; Van de Graaff generator; electroscope.

Experiment: Connect the Van de Graaff generator and electroscope to opposite sides of the glass tube. Connect a syringe with the plunger pushed in to the glass tube drain. While the generator is being charged we do not observe any charge going through the air to the electroscope. Then pull the syringe to 60 ml volume and by doing this reduce the pressure inside the tube by a factor of about twenty.

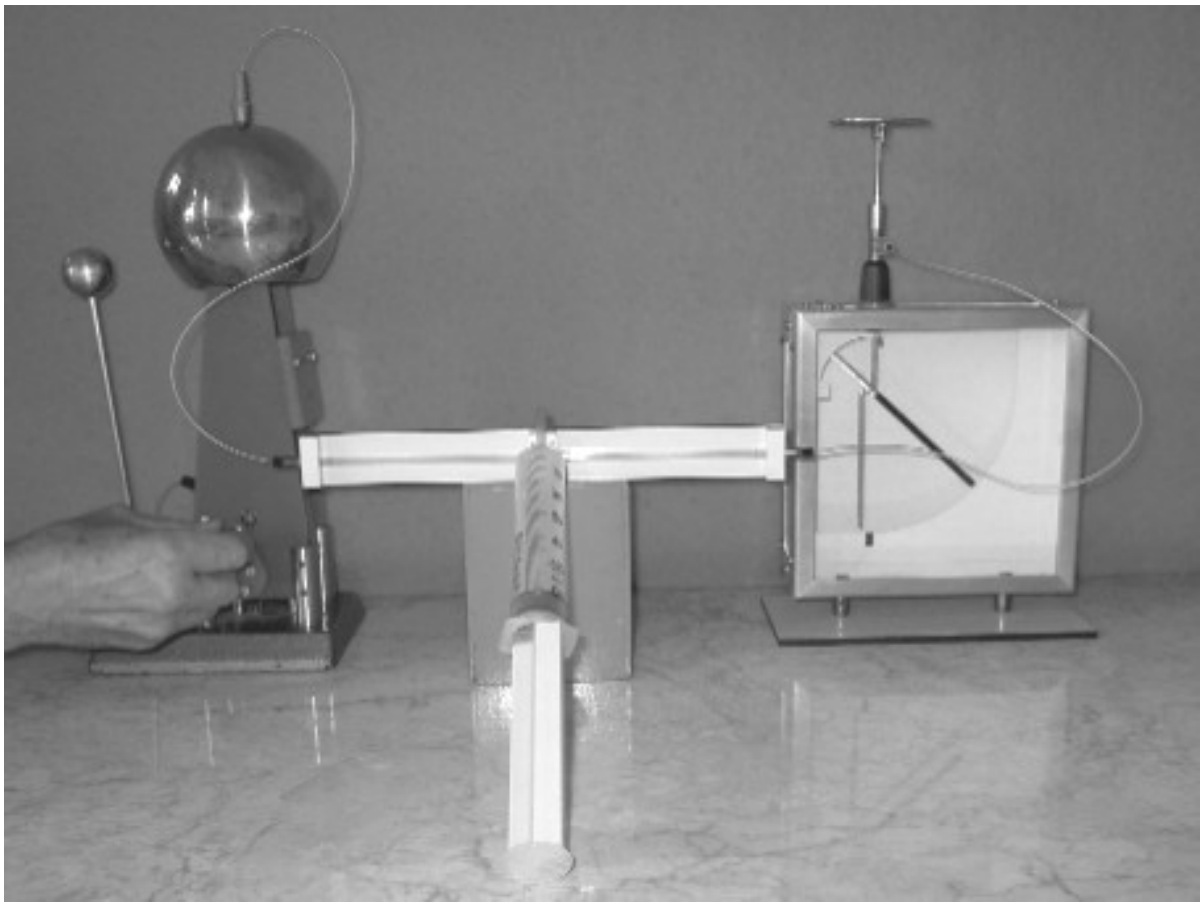

Fig. 1

Fix the piston position by using spacers. The simultaneous effect of high voltage and low pressure results in air ionization and we can see the electroscope being charged even while turning the generator handle (fig. 1). We can conclude that there was electric current flowing temporarily through the air inside the tube.

Electric current in a gas at high pressure

Tools: A transparent plastic bottle with a spark-gap at a half of its height, closed by a lid with a valve. The distance between the spark-gap electrodes should be about 8-10 mm. Other equipment needed consists of a, Van de Graaff generator, wires, and a bicycle pump.

Experiment: Connect the electrodes of the spark-gap to the conductors of the Van de Graaff generator (fig. 2). At some rotation speed of the generator you can observe single discharges. Count the number of turns of the generator and the number of discharges per a time period. Then raise the air pressure inside using the bicycle pump and repeat the experiment. When compared to the previous measurement we can conclude that at higher pressure more charge is needed and the discharge occurs at a higher voltage.

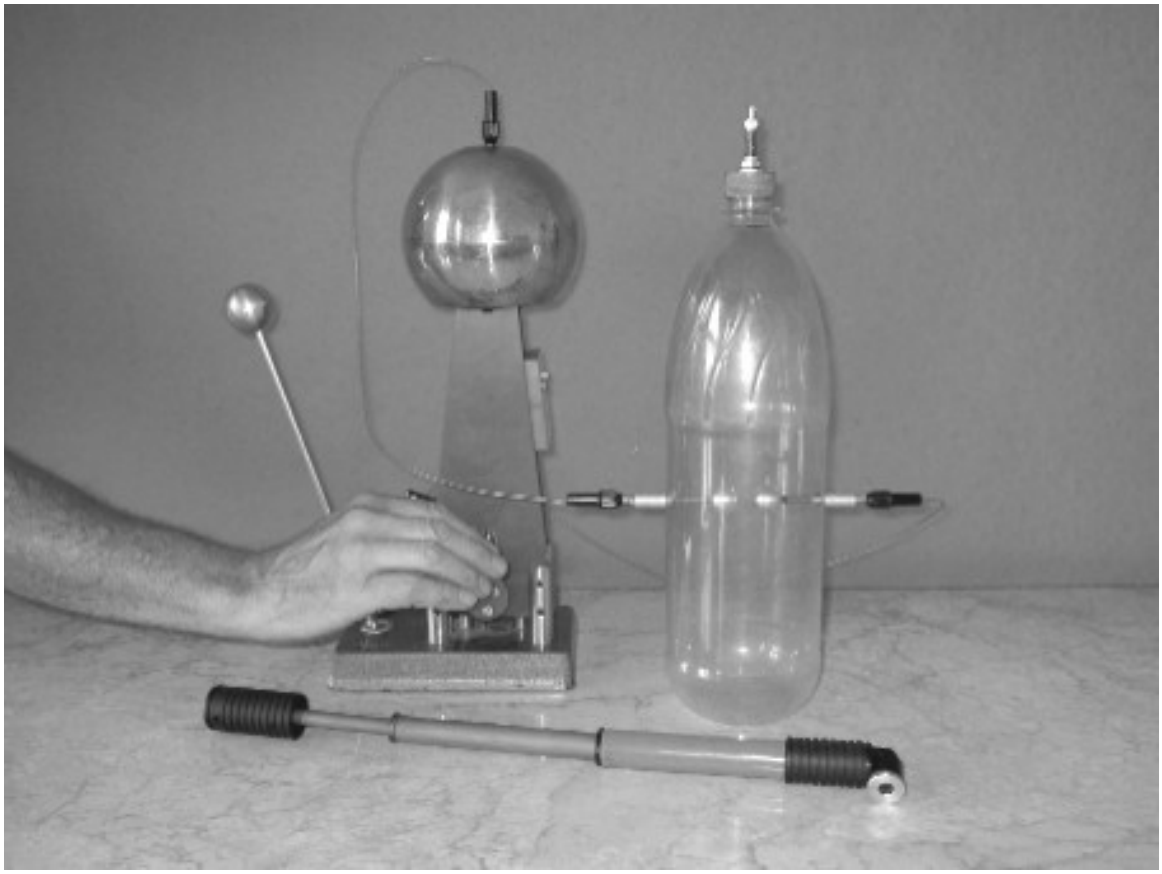

Fig. 2

References

[1] Trnka, Zdeněk: *Úvod do theoretické elektrotechniky.* Elektrotechnický svaz československý, 1946. s. 44