The Physics Experiments of Robert Wichard Pohl (1884–1976)

For decades, Robert Wichard Pohl taught his famous lectures of introductory physics in the old lecture hall of the Physics Institute at Goettingen University. These lectures became the foundation for three volumes entitled „Introduction into Physics". Now, using Professor Pohl's original instruments in the same lecture hall in which he taught, this set of videos captures his extraordinary ingenuity and once more brings to life Pohl's great experimental skills.

Inertia of the magnetic field: Delay of current flow due to self-inductance

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Abstract: The switching of electric devices is usually characterized by their instantaneous response. The presence of inductors with large self-inductance can, however, cause considerable delays. Iron cores can lead to additional delays resulting from a change of the magnetization. Such delays, extending over minutes, will be shown here.

Source: Pohls Einführung in die Physik - Elektrizitätslehre und Optik. Lüders, Klaus; Pohl, Robert Otto (Hrsg.) 22. Aufl., 2006, Springer Berlin Heidelberg New York; p. 124, 125

Key words: Electricity and magnetism, self-inductance, magnetization

Goal of the experiment: The switching of electric devices is usually characterized by their instantaneous response. The presence of inductors with large self-inductance can, however, cause considerable delays. Iron cores can lead to additional delays resulting from a change of the magnetization. Such delays, extending over minutes, will be shown here.

Experimental setup: A large copper spool is wound on a heavy closed iron core. It can be connected with a switch to a 2 Volt accumulator (lead-acid battery) and a projection ammeter of short response time (less than 1 sec). The time is measured with a large, hand-operated (historic) clock .

Experiment:

1. As soon as the switch is closed, the ammeter begins to move, but it progresses very slowly. Only after almost one minute has the current, and with it the magnetic field, reached its saturation value (15 mA).

2. The battery is short-circuited and then removed from the circuit (by throwing another switch), without disrupting the current flowing through the inductor. Again, the inertia of current and magnetic field is seen: It takes approximately one minute for the current to decay to zero.

3. The direction of the current flow through the inductor is reversed, and the step 1 is repeated. This time, the ammeter moves even more slowly, thus testing the patience of the experimenters. Only after two minutes has the current reached its steady state value. In addition to the slow buildup of current and magnetic field, a further delay has been caused by the change of the direction of the magnetization which also takes time.

These experiments always are extremely surprising, considering that we tend to connect in our minds electric phenomena with the idea of the instantaneous, the timeless.

Scientific Contributors:

Klaus Lüders	Department of Physics, Free University Berlin, Germany
Robert Otto Pohl	Laboratory of Atomic and Solid State Physics, Cornell University, Ithaca, USA
Gustav Beuermann	I. Physical Institute, University Goettingen, Germany
Konrad Samwer	I. Physical Institute, University Goettingen, Germany

Editor: Walter Stickan
Camera: Kuno Lechner
Assistant: Verena Gruber
Sound: Frank Polomsky
Video Editing: Abbas Yousefpour
Technical Assistant: Joachim Feist

Production and Distribution: IWF Wissen und Medien gGmbH, http://www.iwf.de, © IWF Goettingen 2006

IWF Wissen und Medien gGmbH
Nonnenstieg 72, D-37075 Goettingen
Phone: +49 (0) 551 5024 0
www.iwf.de

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KNOWLEDGE AND MEDIA