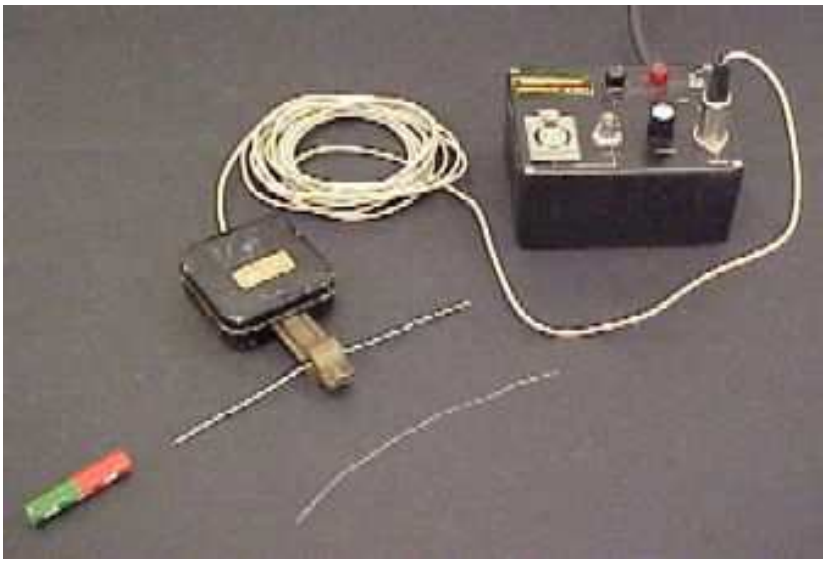
Barkhausen effect (1)

Aim:

- To make the turning of the magnetic domains audible.
- To show hysteresis.

Subjects: 5G20 (Magnet Domains and Magnetization)
5G40 (Hysteresis)

Diagram:



Equipment:

- Solenoid, n=3000.
- Pre-amplifier.
- Speaker.
- (Oscilloscope.)
- Steel wire (paperclip).
- Iron wire (soft iron).
- Bar magnet.

Safety:

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Barkhausen effect (1)

Presentation: Preparation:
The output of the pre-amplifier is connected to the audio system of the lecture-hall. Set the pre-amplifier and audio system at an appropriate level.
Presentation:
-The iron wire is placed inside the solenoid, keeping it in place by hand. Then, with the other hand, one pole of a bar magnet slowly approaches the iron wire. At a certain distance a "groaning" sound is heard in the speaker. When the pole moves away from the iron wire, the "groaning" is heard again, but weaker this time. When next we approach the wire with the magnet with the other pole, again a loud rasping sound is heard.
-Then, the steel wire is placed inside the coil.
Repeating the experiment, again the rasping sound is heard. Moving the magnetic pole away from the wire, no sound is heard. Also, when the same pole approaches the steel wire again, no sound is heard. Only when the other magnetic pole approaches the steel wire, the rasping sound is heard again.

Explanation: When a bar magnet is moving towards a soft iron core, the elementary magnets align themselves intermittently in the direction of the magnetizing field. As each group of magnets turn over, a feeble emf is induced in the solenoid. When the bar magnet moves away from the soft-iron core, not all elementary magnets return to their original orientation (hysteresis) and so a lower emf is induced in the solenoid. This effect of hysteresis is much stronger in the steel wire (paperclip).

Remarks:

- The induced emf can also be made visible by using an oscilloscope.

Sources:

- Biezeveld, H. and Mathot, L., Scoop, Natuurkunde voor de bovenbouw, part 4/5 vwo, pag. 222.
- Friedrich, Artur, Handbuch der experimentellen Schulphysik, part 6, Elektrizitätslehre I, pag. 178.
- Sutton, Richard Manliffe, Demonstration experiments in Physics, pag. 285.
- Griffith, D. J., Introduction to Electrodynamics, pag. 278-281.