

Electromagnetic Fields

– Laboratory 01

Thermal Engineering

Derived from Electrical

Energy

#	Student ID	Student Name	Grade (10)	Instructor signature
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Experiment 01: Bimetallic Fuse

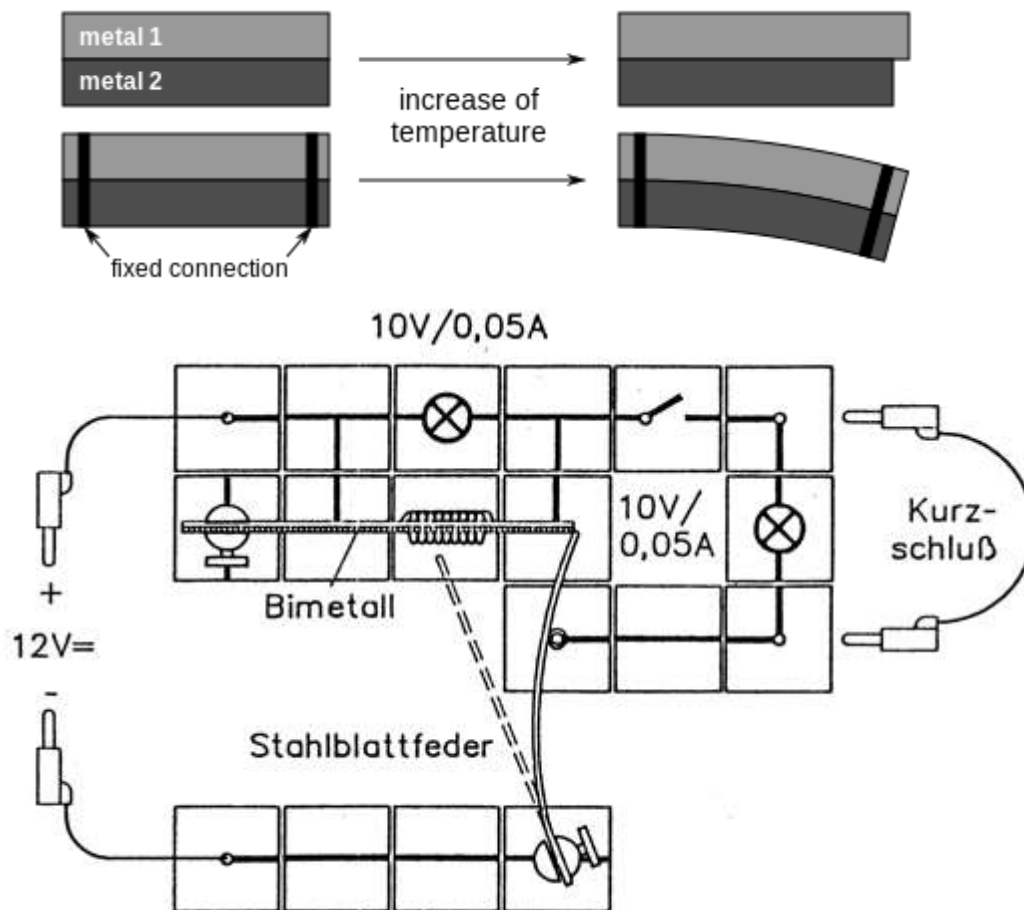
Objective

To test the electrical energy effect on bimetal strips, and how to apply that concept in building protection fuses and circuit breakers

Theory Overview

Bimetal strips are used in miniature circuit breakers to protect circuits from excess current. A coil of wire is used to heat a bimetal strip, which bends and operates a linkage that unlatches a spring-operated contact. This interrupts the circuit and can be reset when the bimetal strip has cooled down.

Bimetal strips are also used in time-delay relays, lamp flashers, and fluorescent lamp starters. In some devices the current running directly through the bimetal strip is sufficient to heat it and operate contacts directly.



Procedure

Arrangement of the wiring according to the illustration.

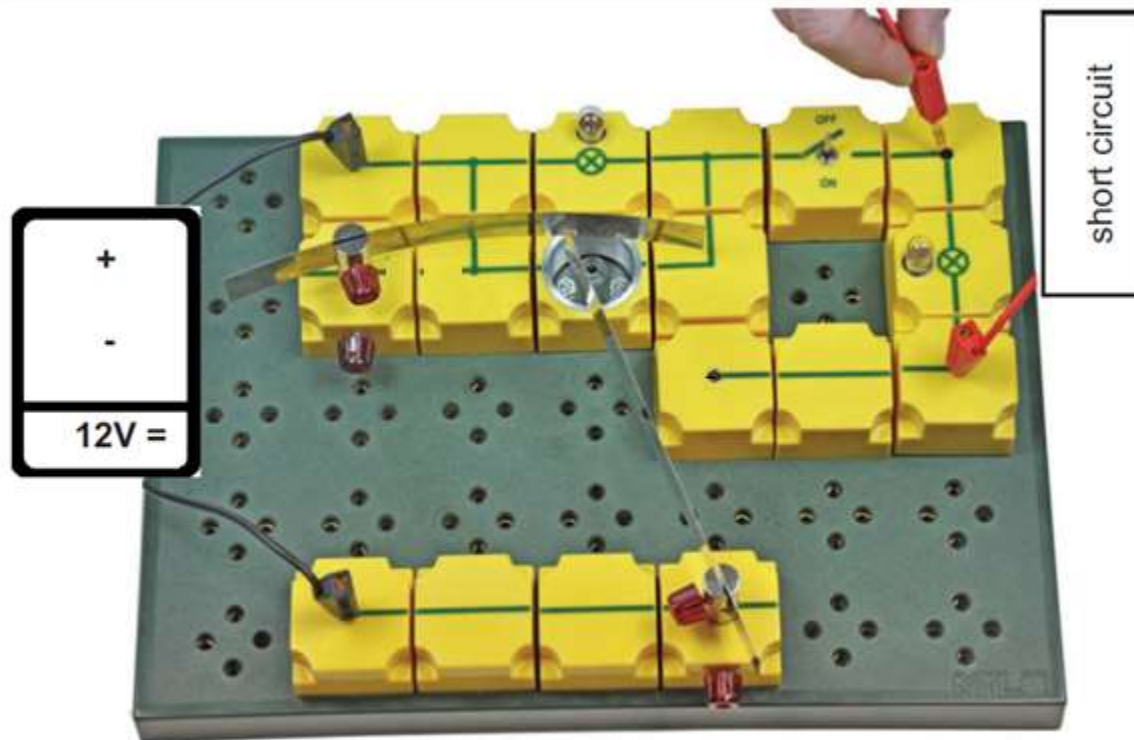
After inserting all plug-in blocks in the circuit board the following arrangements are to be made very carefully:

The flat spring has its neutral position in the position marked by hatching.

Its distance to the crocodile clip with plug pins inserted in A is about 5 mm.

The bimetallic strip outside (patterened side pointed to the front) is moved from the left side towards the end of the flat spring exactly above the heating spiral.

It slightly presses against the crocodile clip with plug pin at A. 12 V DC is applied.



The switch is closed.

The circuit is closed because the flat spring contacts the crocodile clip at A and the right lamp glows.

The upper lamp connected in parallel with the heating spiral does not yet glow.

The right lamp is short-circuited.

Now the upper lamp indicates a voltage through the heating spiral which causes it to glow.

After a short while the bimetallic strip bends and releases the end of the flat spring.

The flat spring springs back to its neutral position, thus the circuit is interrupted.

Questions and Conclusions

1. How long it takes for the disconnection to occur? (in sec)?

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2. Assume that you didn't apply short circuit over the right lamp. Do you think that disconnection will occur if you leave the circuit for proper time? And why? Check your answer by testing that assumption?

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Experiment 02: Bimetallic thermostat

Objective

A thermostat is used to switch a source of heat (or cold) on or off in a way that a desired temperature is kept constant as far as possible.

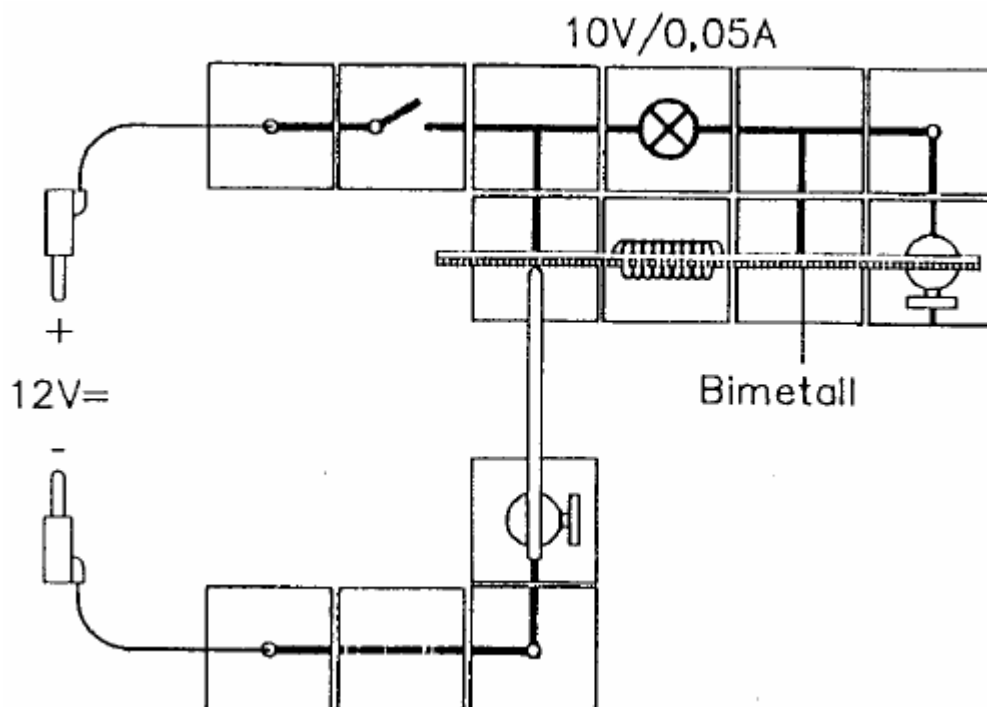
Theory Overview

In the regulation of heating and cooling, thermostats that operate over a wide range of temperatures are used.

In these, one end of the bimetallic strip is mechanically fixed and attached to an electrical power source, while the other (moving) end carries an electrical contact.

In adjustable thermostats another contact is positioned with a regulating knob or lever. The position so set controls the regulated temperature, called the set point.

Procedure



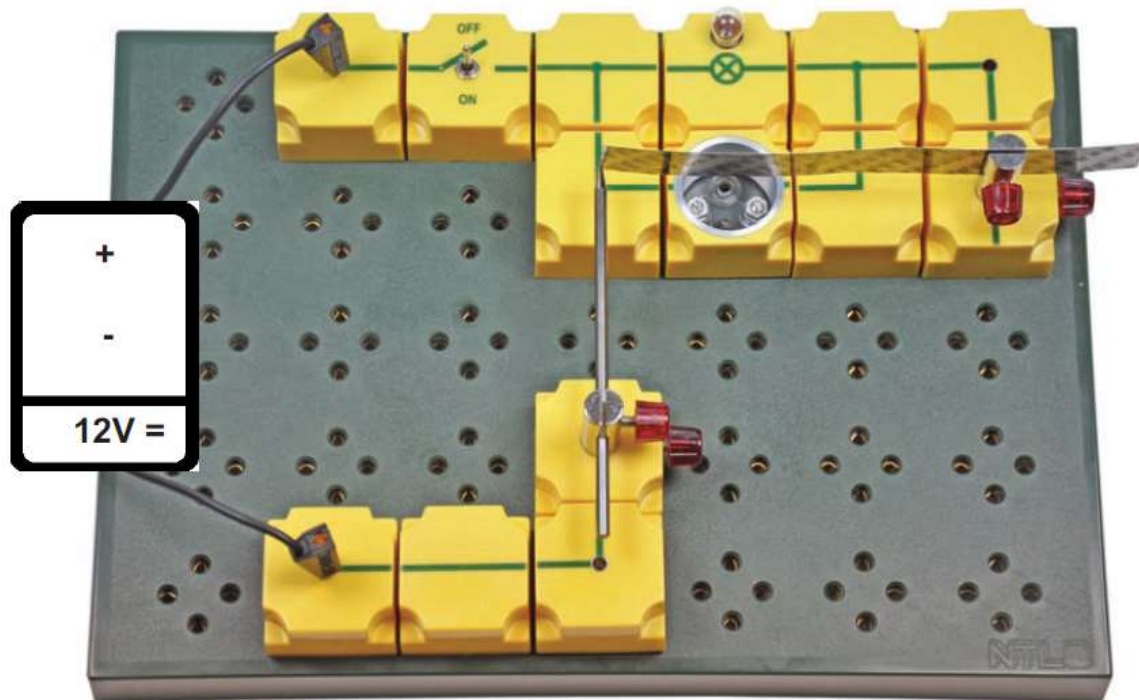
Arrangement of the wiring according to the illustration.

The circuit leads from the upper connection via incandscnt lamp and heating spiral, which are connected in parallel, to the bimetallic strip (patterned side points to the front). The contact pin is pressed slightly against the bimetallic strip until the contact is closed.

Then it is clamped to the bimetallic strip

The switch is closed, thus causing the lamp and the heating spiral to glow. After a short while the bimetallic strip gets so hot that it bends and retreats from the contact pin. The circuit is interrupted.

The heating of the bimetallic strip stops. The bimetallic strip re-bends to its original position when it is cooled. The contact is closed again, etc.



Questions and Conclusions

1. How long it takes for the disconnection to occur? (in sec)?

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2. Suggest a solution to make the circuit cut at a higher temp?

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Experiment 03: Bimetallic fire alarm

Objective

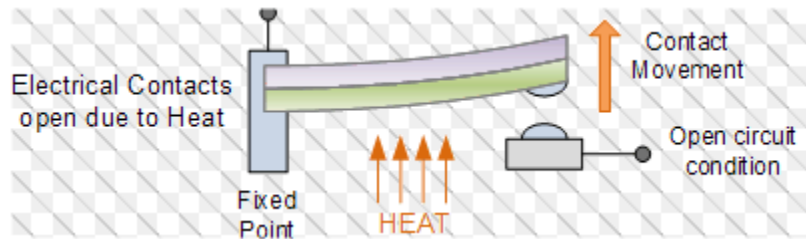
An automatic fire alarm in a building's security system is a heat detector that responds to the heat from a fire by setting off an alarm. Some heat detecting fire alarms rely on a bimetallic strip as the temperature sensor. This strip responds to heat by opening a normally closed electrical circuit to activate the alarm.

Theory Overview

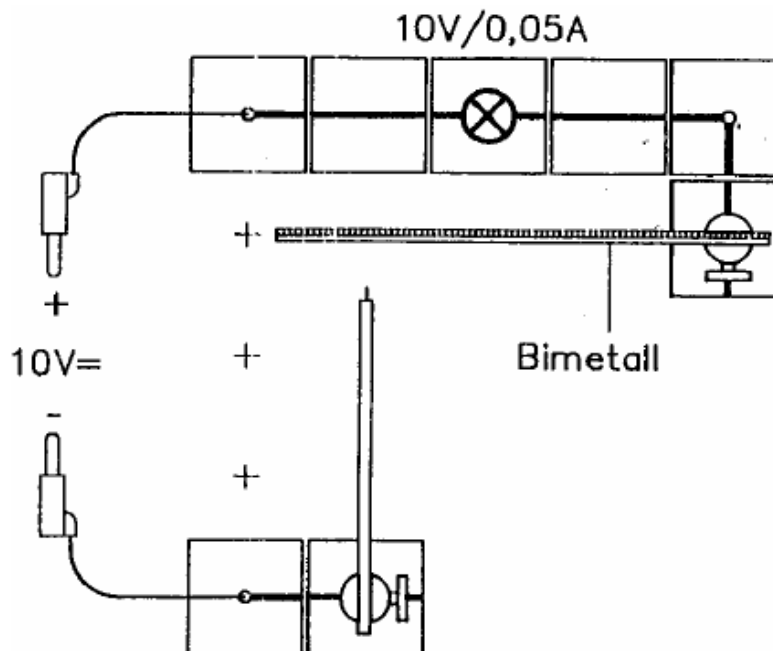
The bimetallic strip in a fire alarm is made of two metals with different expansion rates bonded together to form one piece of metal. Typically, the low-expansion side is made of a nickel-iron alloy called Invar, while the high-expansion side is an alloy of copper or nickel.

The strip is electrically energized with a low-voltage current.

When the strip is heated by fire, the high-expansion side bends the strip toward an electrical contact. When the strip touches that contact, it completes a circuit that triggers the alarm to sound. The width of the gap between the contacts determines the temperature that will set off the alarm.



Procedure



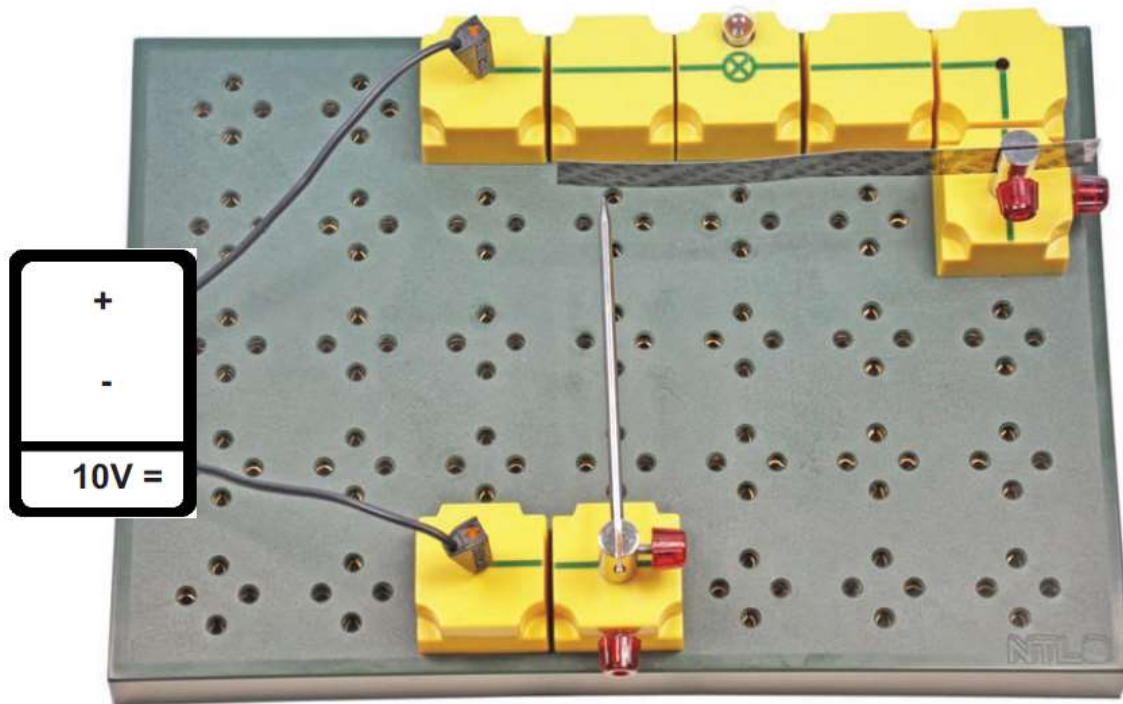
Procedure

Arrangement of the wiring according to the illustration.

The bimetallic strip is clamped to the adapter bush in such a way that the side which is not patterned faces the contact pin.

The contact pin is 5 mm away from the bimetallic strip.

Thus the circuit is still interrupted. Either a lamp E 10, 10 V/0,05 A or a buzzer are inserted in the circuit.



The bimetallic strip is heated in the middle by means of a burning match.

It bends and closes the circuit thus causing an alarm to go off (the buzzer sounds or the lamp glows).

Questions and Conclusions

1. How long it takes for the disconnection to occur? (in sec)?

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2. Dose the built bimetallic fire sensor effect with other environmental conditions like vibration or movement; justify your answer with testing?

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3. From your answer of 1, 2 state two main advantages and two main disadvantages of bimetallic fire sensors?

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