

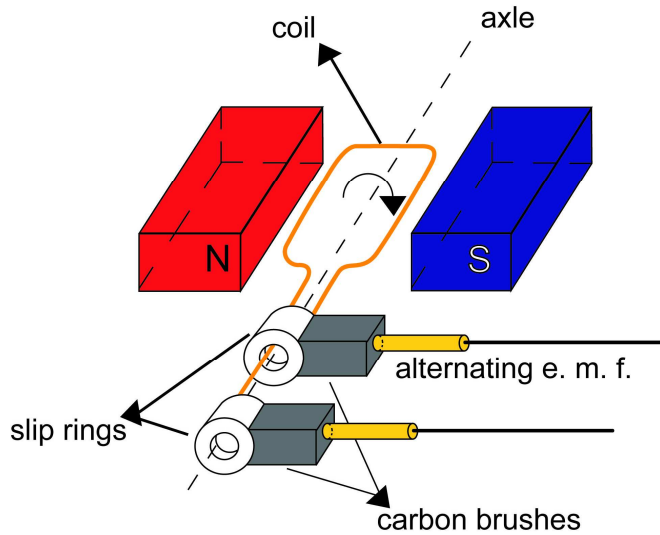
USES OF ALTERNATING CURRENT

1. Simple a.c. and d.c. generators and motors

http://www.walter-fendt.de/ph14e/generator_e.htm

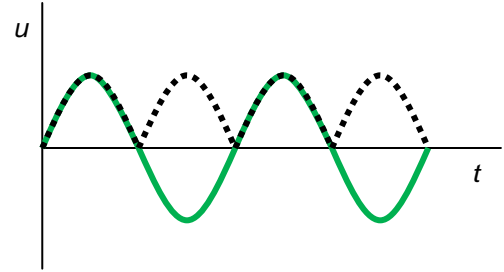
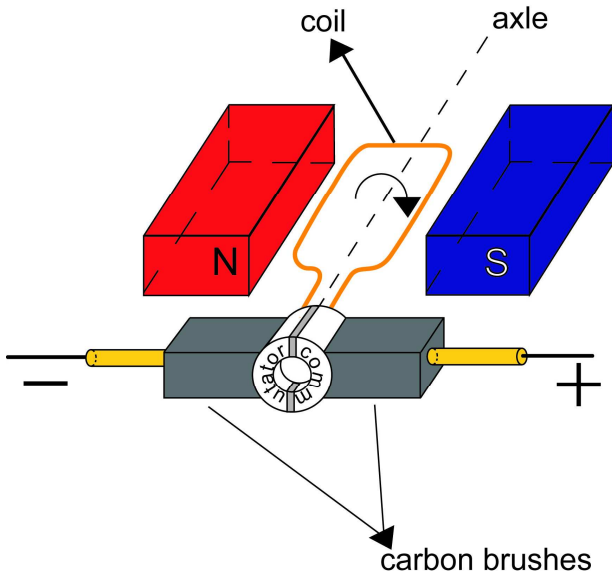
<http://phet.colorado.edu/en/simulation/generator>

a) a.c. generator and motor – explain their function



b) d.c. generator and motor – explain their function

<http://www.k-wz.de/physik/threephasegenerator.html>

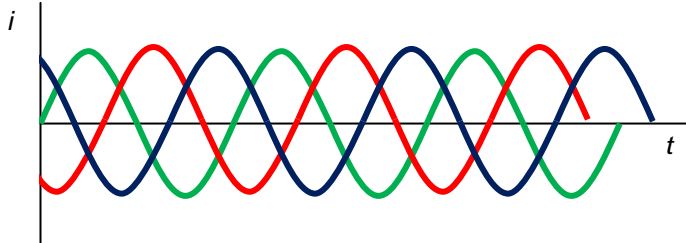


2. Three phase generator and motor

<http://www.k-wz.de/physik/threephasegenerator.html>

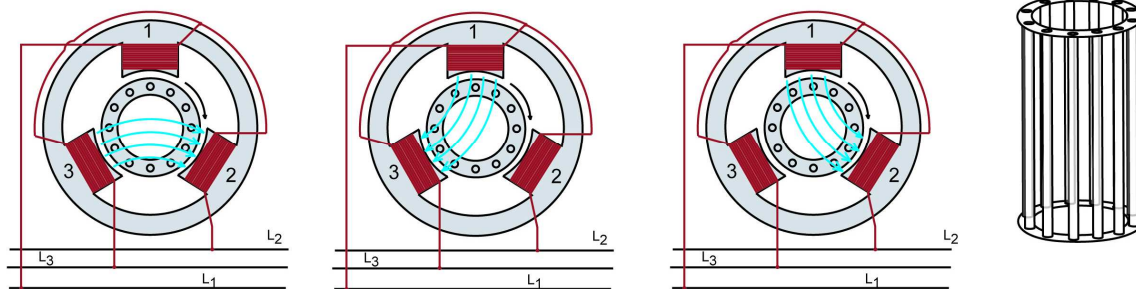
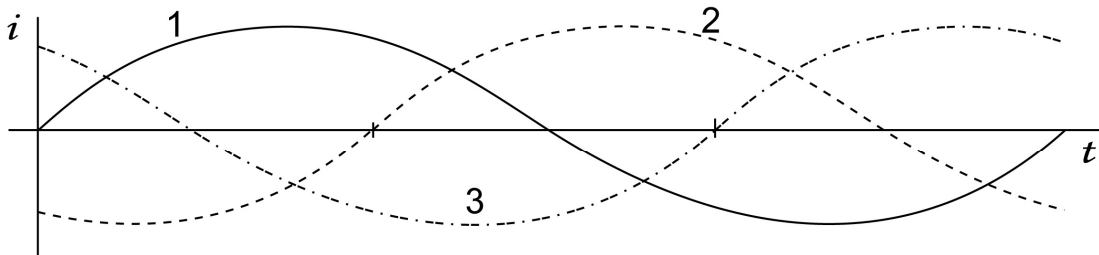
a) the 3-phase induction motor – explain the function

Current supplied must obey the following graph:



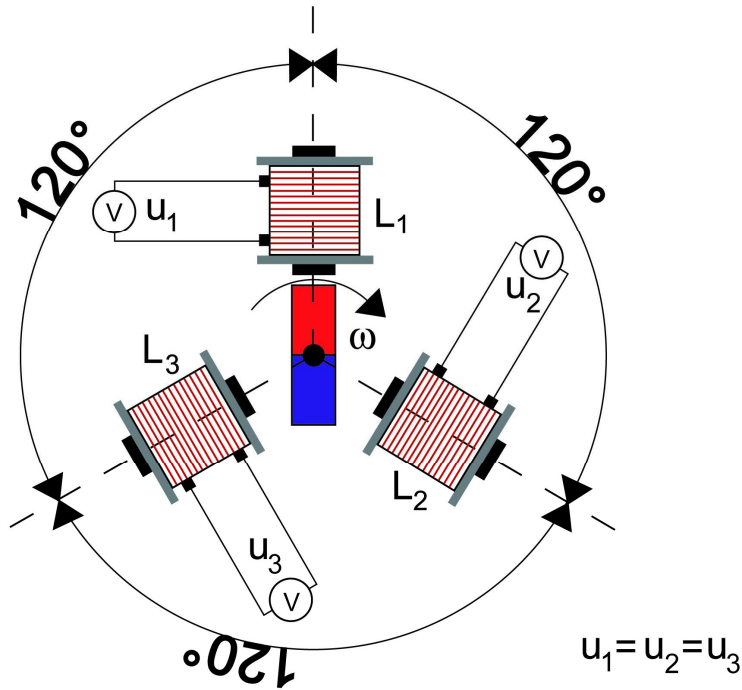
Three different inputs into three different..... (stator) – changing current in the coils creates a magnetic field inside – in a conductor (squirrel cage) inside can be induced – magnet – follows the changes of the outer field – of the squirrel cage (rotor)

Fill in the words: eddy currents, sets of coils, changing, rotation

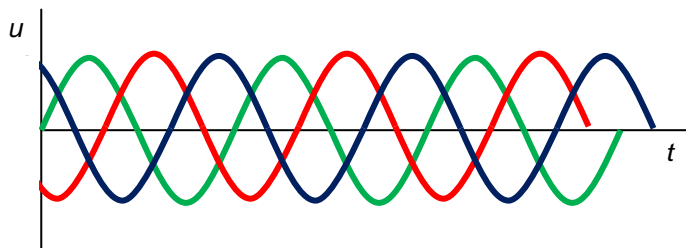


Note: We can use a magnet rotating inside the set of coils instead the squirrel cage, so that there is no delay. This motor is in general less suitable for powerful machines.

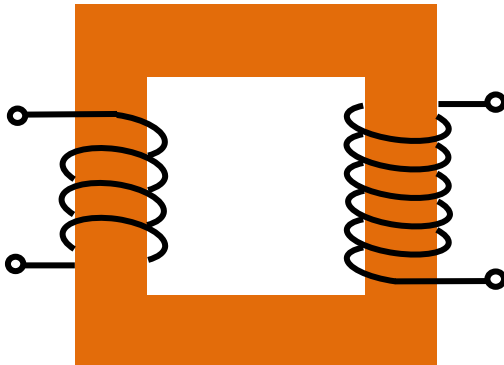
b) three phase generator - induction of electricity in a power station – explain the process



We supply mechanical energy to rotate an (electro)magnet – *rotor* – inside a system of coils – *stator*. For the coils the magnetic field changes and voltage is induced according to the graph below.



3. Transformer and its efficiency



A transformer is a device used to of alternating voltage and current. It consists of two coils and a common core made of = laminations. The alternating current passes the primary coil and it creates a magnetic field around it. This field is by the iron core and with the secondary coil. Due to electromagnetic induction, voltage is on the secondary coil.

Fill in the words: *changing, change the value, shared, induced, reinforced, sheets of iron*

In an ideal situation (no energy converted into other types) the number of loops/turns of the coils is directly proportional to the voltage induced and it obeys the eqn.

$$k = \frac{N_2}{N_1} = \frac{U_2}{U_1}$$

step-up transformers: $k > 1 \Rightarrow N_2 > N_1 \Rightarrow U_2 > U_1$

step-down transformers: $k < 1 \Rightarrow \dots\dots\dots$ *finish according to relations above*

Efficiency

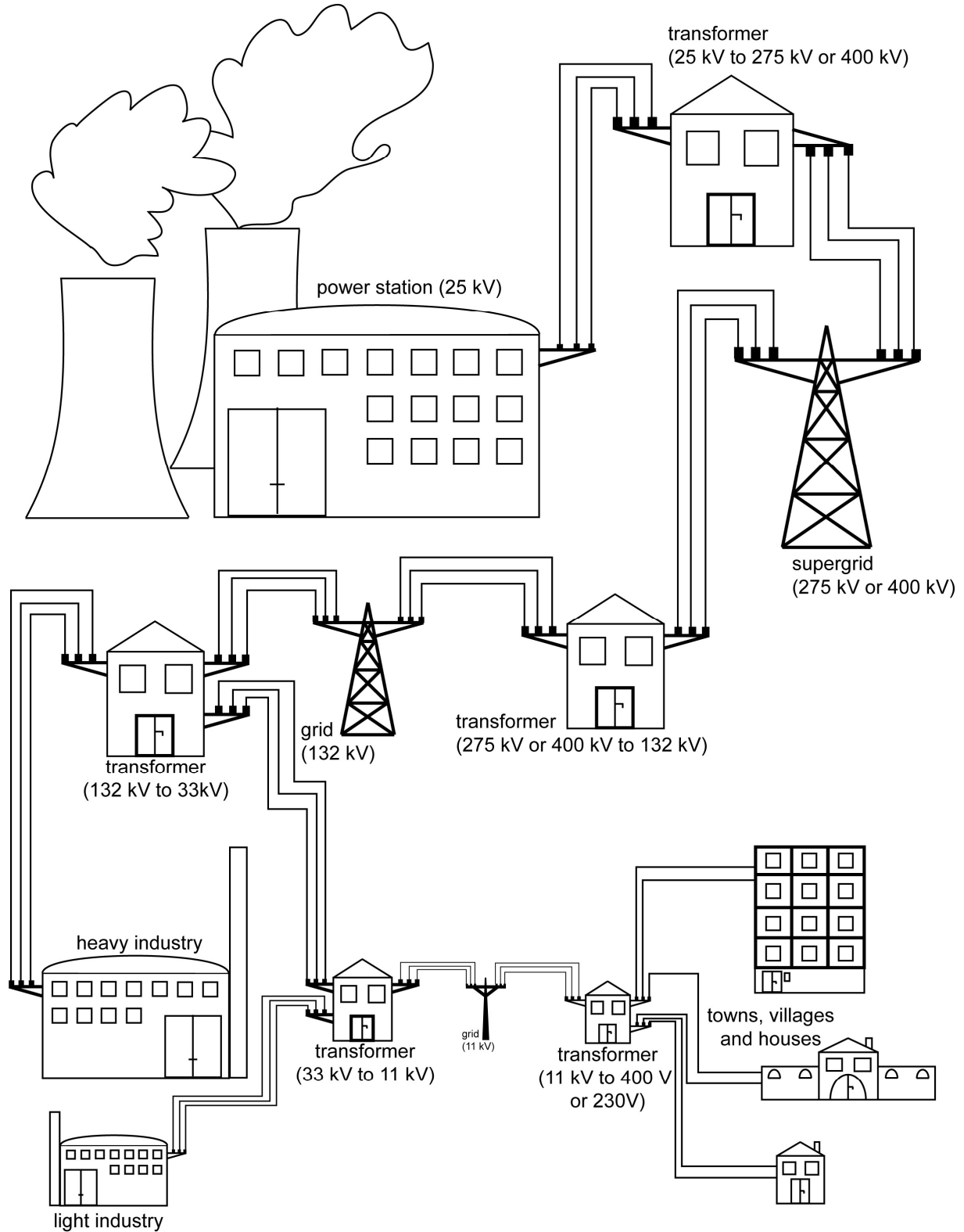
Of course energy should be conserved and because $E = Pt = UIt$ the bigger the voltage induced, the smaller the current induced.

$$k = \frac{U_1}{U_2} = \frac{I_2}{I_1}$$

In real situations the energy loss is about 2-10%, e.g. $P_1 = 0.95 \times P_2$

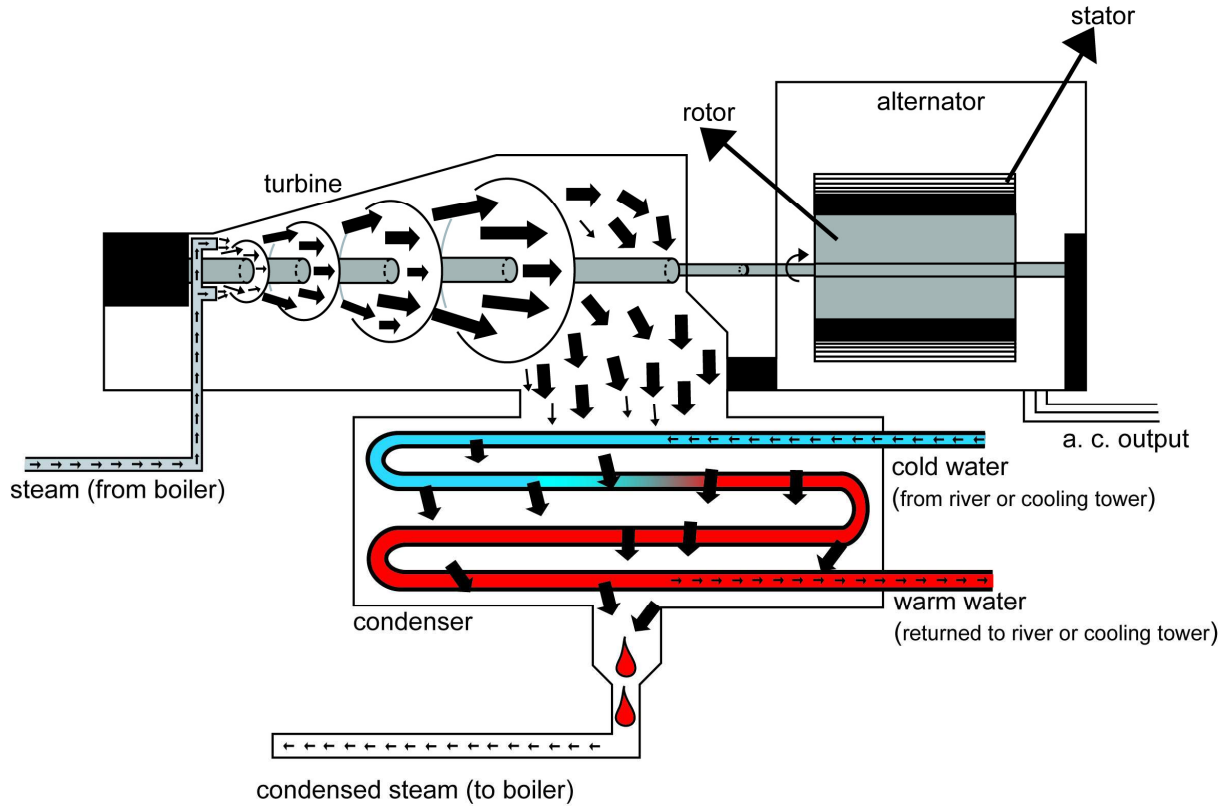
<http://fyzika.jreichl.com/index.php?sekce=browse&page=galerie&page=332&galerie=aplikace>
<http://phet.colorado.edu/en/simulation/faraday>

4. Energy transmission



5. Power stations

<http://kabinet.fyzika.net/dilna/prezentace/vyukove-prezentace.php>



Discuss the difference between water, wind, thermal and nuclear power plant. Find information about interesting types of power plants – tidal,... What do all of them have in common?

6. Safety

Appliance safety in the home

Use and maintain electrical appliances safely around your home:

- Never use a faulty electrical appliance, or one that has a frayed cord, cracked or broken plug, or any appliance that has given someone any kind of shock
- To avoid a shock, switch off power points before plugging and unplugging appliances
- Remove appliances from the power point by holding the plug, not by pulling the cord
- Have appliances serviced in accordance with the manufacturers' instructions
- Never leave your home with appliances such as heaters, ovens and stove-tops operating
- Do not place fan heaters, televisions and electrical equipment in areas with restricted airflow as overheating may occur
- Keep all combustible material (eg. clothes, bed linen, curtains and tea towels) away from stove-tops, heaters and lamps as heat build-up can cause fires
- Ensure you have the correct bulb size and rating (in watts) fitted in lamps according to manufacturers' specifications
- Remove any build-up of materials around the electric motor of exhaust fans (eg. fluff, dust, lint, etc)
- Clean ovens and hot plates regularly to prevent the build-up of spilled fats and burnt foods
- Install a ventilation system, flue or exhaust fan in the kitchen to remove fumes while cooking
- Switch off and unplug your toaster before trying to remove toast, muffins or crumpets that are caught in the toaster
- Remove breadcrumbs from the toaster regularly as a build up can be hazardous
- Never leave cooking unattended. If you must leave the room take something with you as a reminder that you are cooking (eg. a wooden spoon)

Around the house

- Portable generator sets can be just as dangerous as mains supply if misused. Before connecting to house supply, check with your electricity supply authority.
- All outdoor electrical appliances must conform to safety standards, ie. be double insulated

Electricity and children

Teach children that electrical appliances, cords, switches and outlets are not toys. Safety shuttered outlets as well as plastic covers for ordinary type outlets are available. Electric blankets are not recommended for use by babies or young children, who may wet the bed.

If the power fails

Switch off all heating appliances if the power fails – fires have been caused when the power returns unexpectedly. Combustible material must be kept well clear of all heating appliances.

If you receive a shock

Any tingle or slight shock from an electrical appliance should be regarded as a warning. Advise your electricity authority or a registered electrical contractor immediately. Always disconnect the appliance from the power source before touching the appliance, and label it clearly to prevent anyone else from using it until it has been repaired and tested or replace it completely.

Buy local

Some electrical articles purchased overseas may not operate satisfactorily under Czech conditions and may not comply with our safety standards – such articles could be hazardous if used without modification. If you purchase electrical articles from overseas, have them checked first before you use them. Make sure they carry a compliance mark issued in CR or EU.

Professional help

Even if you consider yourself to be handy around the home, DO NOT attempt electrical work of any kind. ALWAYS get it done by a registered electrical contractor – the knowledge and experience of that person is your best protection.

Emergency procedures – helping others and protecting yourself

If someone receives an electric shock, the person is electrified until released. Take precautions to prevent receiving a shock yourself by immediately switching off the electricity where practical. The person must be pulled or pushed clear of hazard using dry non-conducting material such as wood, rope, clothing, rubber or plastic. DO NOT use metal or anything moist. Where necessary, prevent the person from sustaining further injury by falling. Send for an ambulance or a doctor immediately. The first 3 minutes are vital – act immediately to assess their level of consciousness and then, if the person is not breathing, commence resuscitation.

<http://www.energex.com.au/safety/index.html>

<http://www.e-bozp.cz/?gclid=CNSDr4qa-KICFQ0gZwodiTFhlg>

Questions:

1. What is the difference between a generator and motor?
2. What is the function of a commutator?
3. Sketch the U-time graph for the voltage induced in the coil of a d.c. generator.
4. Explain the function of all the devices in the topic.
5. Why do we use a.c. in homes and in industry?
6. Why is energy transmitted at high voltage?
7. Design an experiment to prove how efficient the transformer is and how to improve the efficiency.