

Exemples d'application (principes de base)



- Bougie de moteur à explosion (inductance)
- Soudure par points (condensateur)
- Abaisseur de tension (variateur)
- Elevateur de tension ($>$ tension de la source)
- Lignes électriques (très grandes distances)
- Comparaison de tailles (poids et rendement)

Electrotechnique II

Hello, during the first lesson, we have laid the theoretical bases of the behavior of three linear elements R,L and C with abrupt state fluctuations, that is to say transient states. During this lesson, we will see a few examples of applications that will give you an idea of the importance of transient states. We will see a few examples of applications while keeping in mind that those are basic fundamentals that are relatively simplified for the clearness of the explanations. I hope that these examples will help you and will arouse your curiosity.

Notes

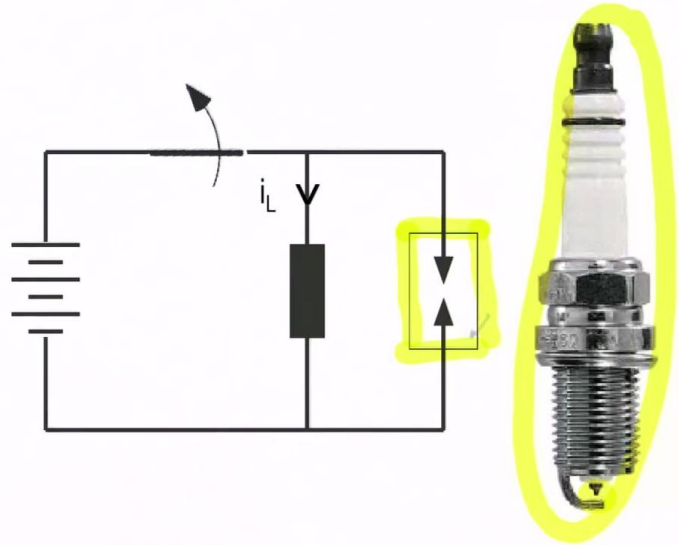
Summary



0m 04s

Bougie de moteur à explosion - (saut de courant dans une inductance)

- Courant dans une inductance
- Ouverture du circuit
 - > Tension de claquage
 - > Etincelle
- Anciennement : vis platinées
- Actuellement : allumage transistoré



Electrotechnique II

Lets see a first application example. It is an engine spark plug. We consider the following circuit that is made of a matrix, the 12V battery of the vehicle an inductance that we call ignition coil, and a switch, that allows a current to go through the inductance, or to shut it off. We connect on the terminals of the inductance a spark plug. This spark plug, with its electrode, here. This spark plug can be represented, here, by this electronic symbol.

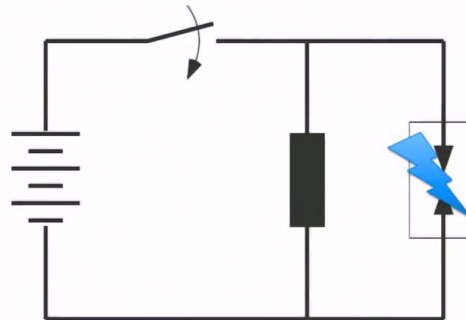
Notes

Summary



Bougie de moteur à explosion - (saut de courant dans une inductance)

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Electrotechnique II

During the current cut in the inductance, we saw during the previous lessons, that an abrupt current cut in an inductance could cause an infinite voltage. Here, the voltage will not be infinite, but it will reach the breakdown voltage of the medium in which the spark plug is. and cause a spark. All the energy stored in the inductance will be found, here on the terminals of the electrodes of the spark plug. This spark will occur on the terminals of the spark plug.

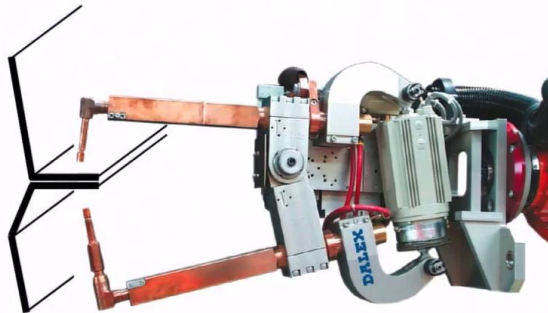
Notes

Summary



Soudure par points - (saut de tension aux bornes d'un condensateur)

- Condensateur chargé
- Quasi court-circuit
 - > Fort courant (10 kA)
 - > Fusion par effet Joule



Electrotechnique II

Lets considerate an second application case, it is the spot welding. This process is used a lot in the industry and consists in assambling metal sheets together. The principle is relatively simple, we start with a charged capacitor that will be in this cabinet, and through two electrodes we will short-cut the capacitor through the plates. We saw that short-circuiting a capacitor is forbidden, and causes high or almost infinite currents here the electric resistance is not perfectly at zero, we will get a current that is extremely high of the order of a few kilo-amps, and by Joule effect so by the heating of the material, we will merge the material, and therefore realise this welding.

Notes

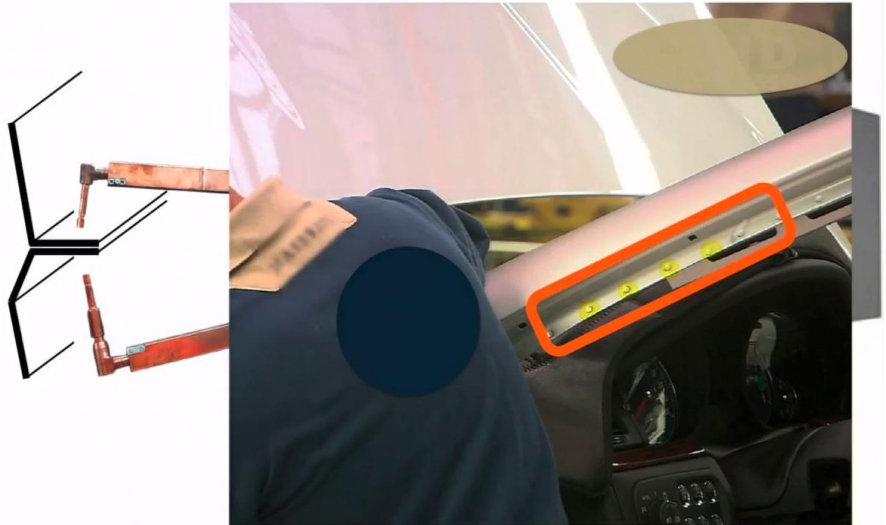
Summary



1m 56s

Soudure par points - (saut de tension aux bornes d'un condensateur)

- Condensateur chargé
- Quasi court-circuit
 - > Fort courant (10 kA)
 - > Fusion par effet Joule



Electrotechnique II

We see, here, an example of achievement with weldings of automotive sheet on those spots.

Notes

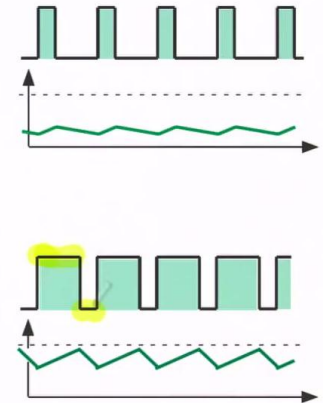
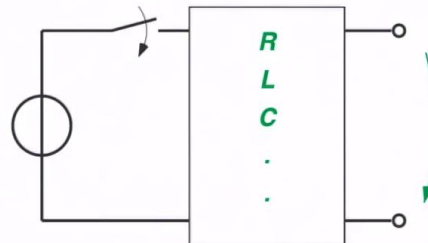
Summary



2m 59s

Alimentations à découpage - (abaisseur de tension)

- Pas de transformateur 50 Hz
- Circuit de hachage
- Fonctionnement en régime transitoire uniquement
 - Gain de poids
 - Augmentation du rendement



Electrotechnique II

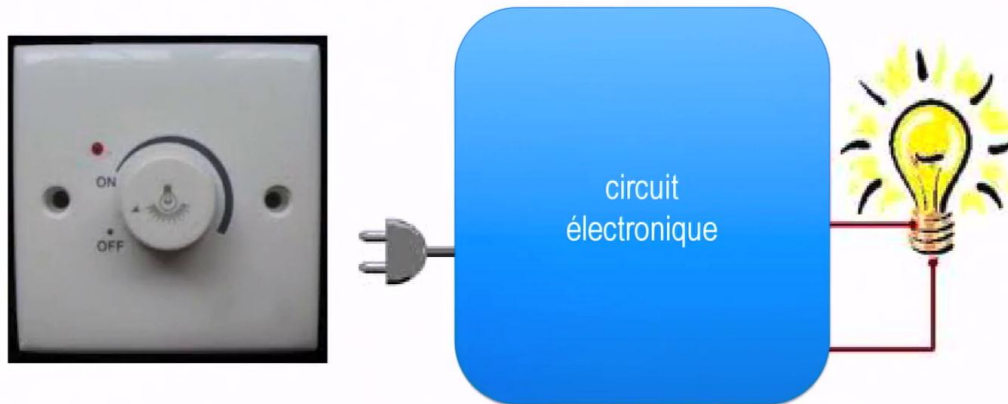
Another application example is SMPS (switching-mode power supply). Here, the goal is to avoid using a transformer like the one we use for electrical networks by replacing it by a chopper circuit. This means that the execution will only be in transient state and we will see that we will have a high weight gain and an increase of the efficiency. We see on this circuit that as function of the voltage, which is constant, given by the voltage supply, here is a sequence of power cuts and interlocks of the circuit so we get, at the output of our circuit, a voltage that can be lowered down to a certain level or, eventually, lowered to a different level as function of the time ratio of the interlocks and the triggering of the circuit.

Notes

Summary



Alimentations à découpage - (**abaisseur** de tension)



VARIATEUR DE TENSION

Abaisseur - P. ex. : Dimmer pour ampoule

Electrotechnique II

This kind of SMPS, also called a switcher is very well known in demotic, for example we all know lightbulb dimmers that allows to reduce the brightness of a lightbulb.

Notes

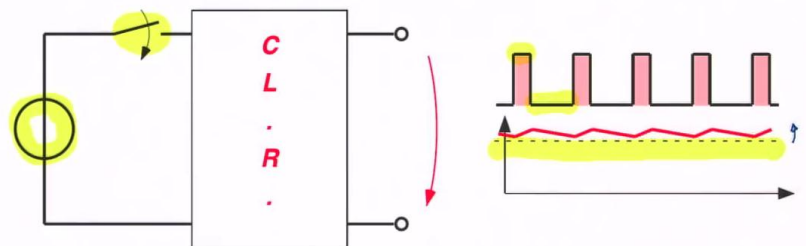
Summary



4m 11s

Alimentations à découpage - (élevateur de tension)

- Pas de transformateur 50 Hz
- Circuit de hachage
- Fonctionnement en régime transitoire uniquement
 - Gain de poids
 - Augmentation du rendement



Electrotechnique II

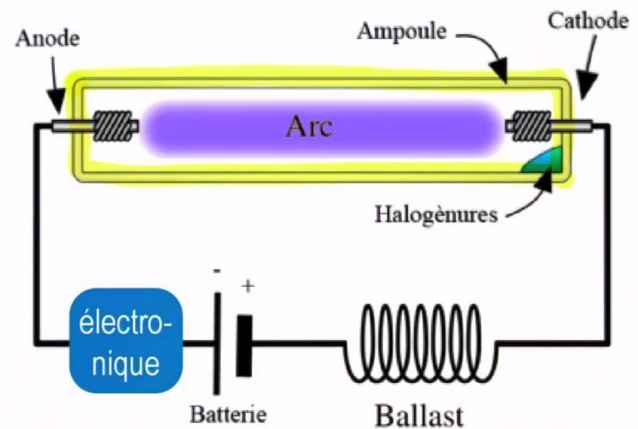
Another example, the switched-mode power supply, but this time used as a voltage step-up. As previously we see that starting at certain continuous voltage which is the voltage supply of the circuit and a sequence of interlocks and triggering of the circuit on its power supply we can have an output voltage higher than the power supply.

Notes

Summary



Alimentations à découpage - (élevateur de tension)



VARIATEUR DE TENSION

Élevateur - P. ex. : Phares au xénon (amorce de l'arc)

Electrotechnique II

An example of the use of an step-up SMPS is the voltage regulator for example the xenon headlamps of a car that we can picture here by this lightbulb with gas in this enclosure This gas is not an electric conductor when it is stable we must create an overvoltage to initiate an electrical arc and therefore causes the flow of the current into the lightbulb, and by this same event the lightning of the lightbulb.

Notes

Summary



Distribution d'énergie sur de très grandes distances



Electrotechnique II

This is now one last application example. It is the energy distribution on very long distances. Here we talk about inter-continent distances.

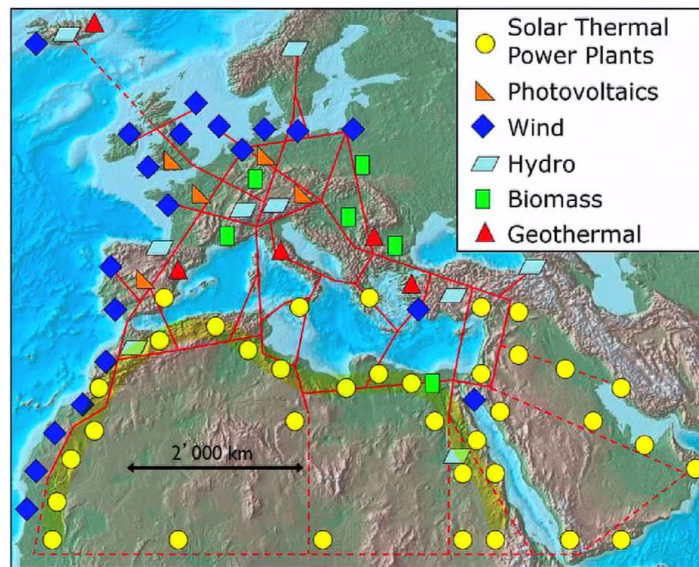
Notes

Summary



5m 38s

Distribution d'énergie sur de très grandes distances



Electrotechnique II

Increasingly, the diversity of the energy supply means that electrical power plants are scattered all throughout Europe, Asia and even Africa and those distances are extremely long, we are talking here of several thousands of kilometers.

Notes

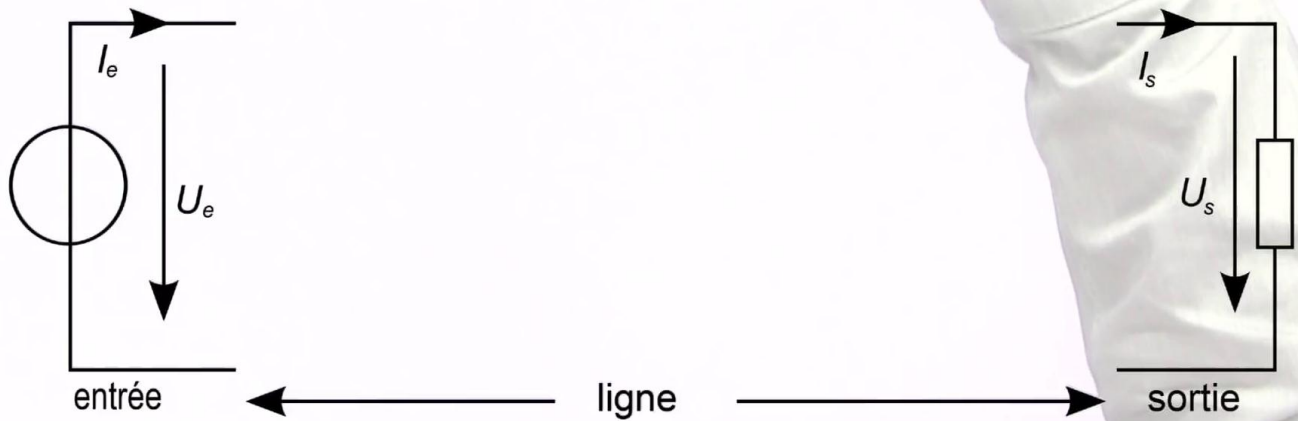
Summary



5m 48s

EXEMPLE D'APPLICATION

Distribution d'énergie sur de très grandes distances



Electrotechnique II

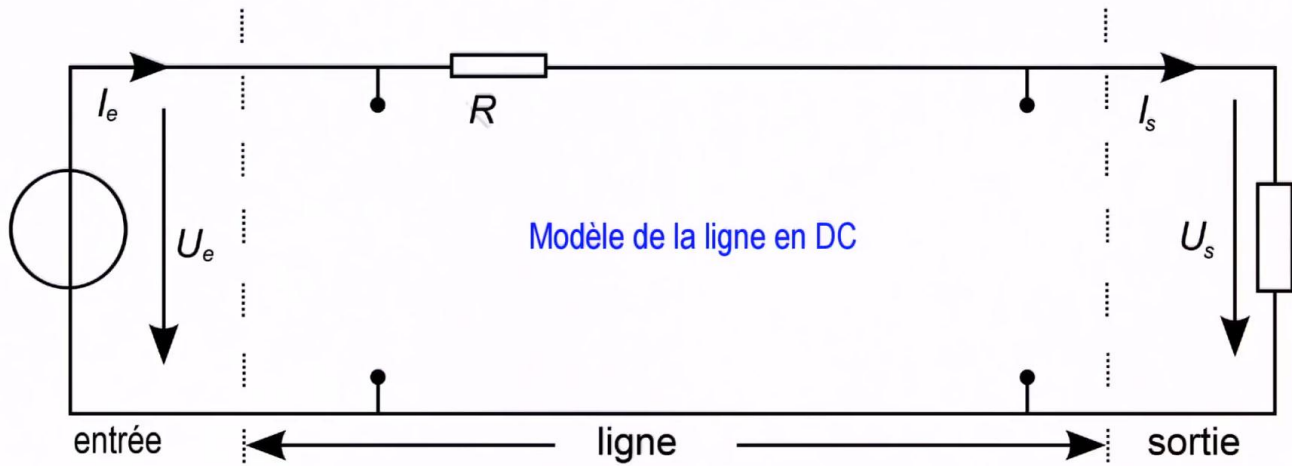
If we look at the electrical distribution line we can see that between the source which is the place where the electricity is produced, and the consumer, here there is an electrical line that is characterized by the following circuit.

Notes

Summary



Distribution d'énergie sur de très grandes distances



Electrotechnique II

A first model of a line in alternative state, we can see that this example has an inductance, here that will be as high as the distance is long and therefore the voltage drops of the inductance terminals will also be high. Capacitors connected in parallel, that represent the current leaks in the electrical line. Those capacitors are as big as the line is long too, and therefore the impedance the impedance, seen by the line of this constructor, will be as small as the current leaks are big (in this example). hence the interest to move to a DC state. We have, here, the sketch where the example of the DC line where the inductances and capacitors have disappeared because the frequency is zero. So, there is only this resistor left.

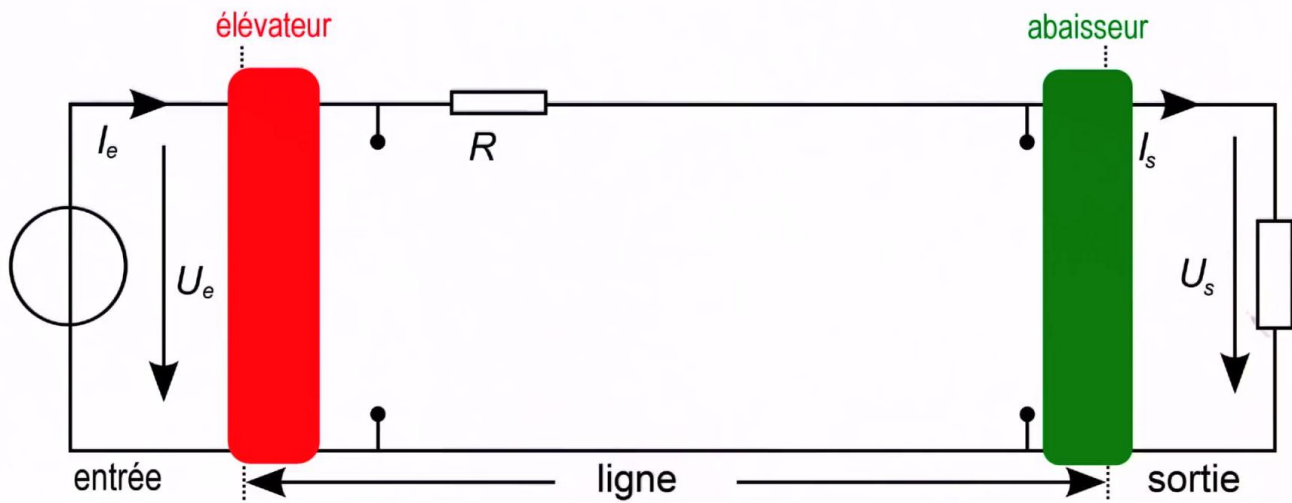
Notes

Summary



6m 37s

Distribution d'énergie sur de très grandes distances



Electrotechnique II

Just like the energy distribution on long distances using the alternative state we need to rise the voltage to lower the current for a given power and therefore, we will, here create a step-up voltage, that allows the energy transport at a high voltage and then a voltage reducer that allows to reuse this voltage, in a lower form directly by the consumer.

Notes

Summary



7m 36s

Comparaison des tailles

Alimentations ..

.. linéaire >



< .. à découpage

Electrotechnique II

Finally we will compare the size of different power supplies. We see here that the classic power supply made with an alternative 50 Hz transformer and here a switched-mode power supply, we see that this one is much more compact.

Notes

Summary



Comparaison des tailles

Alimentations ..

..linéaire >



< .. à découpage

..linéaire



.. à découpage

Electrotechnique II

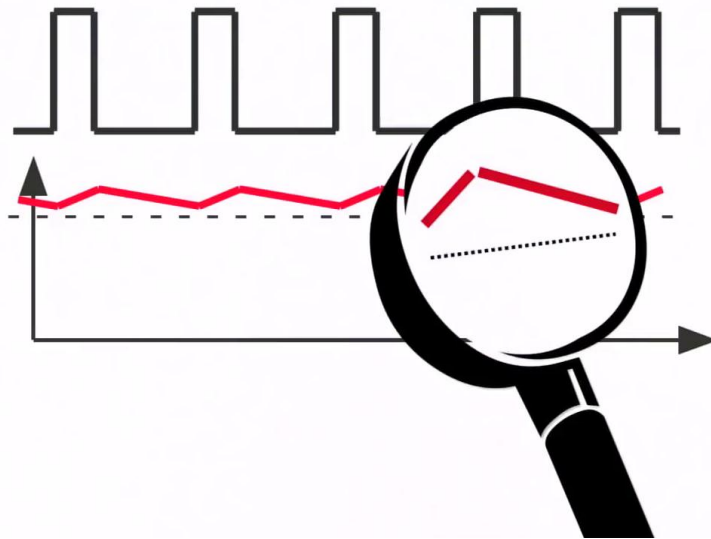
This seconde example shows very well the difference of two power-supplies one, with a transformer, and the other one with a switch-mode for a same given power, we can see that the SMPS (switched-mode power supply) is much more compact.

Notes

Summary



Conclusion : importance de fonctionnements en régime transitoire



Electrotechnique II

Those few examples show the diversity and the importance of these transient states in many devices. During the following lessons, we will study the details and learn how to solve such transient states.

Notes

Summary

