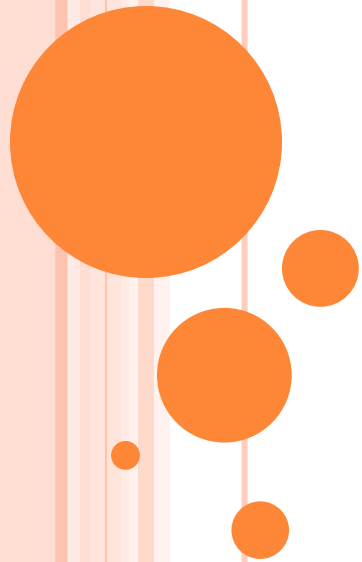


LECTURE 10

X-RAY CIRCUITS



KAAB

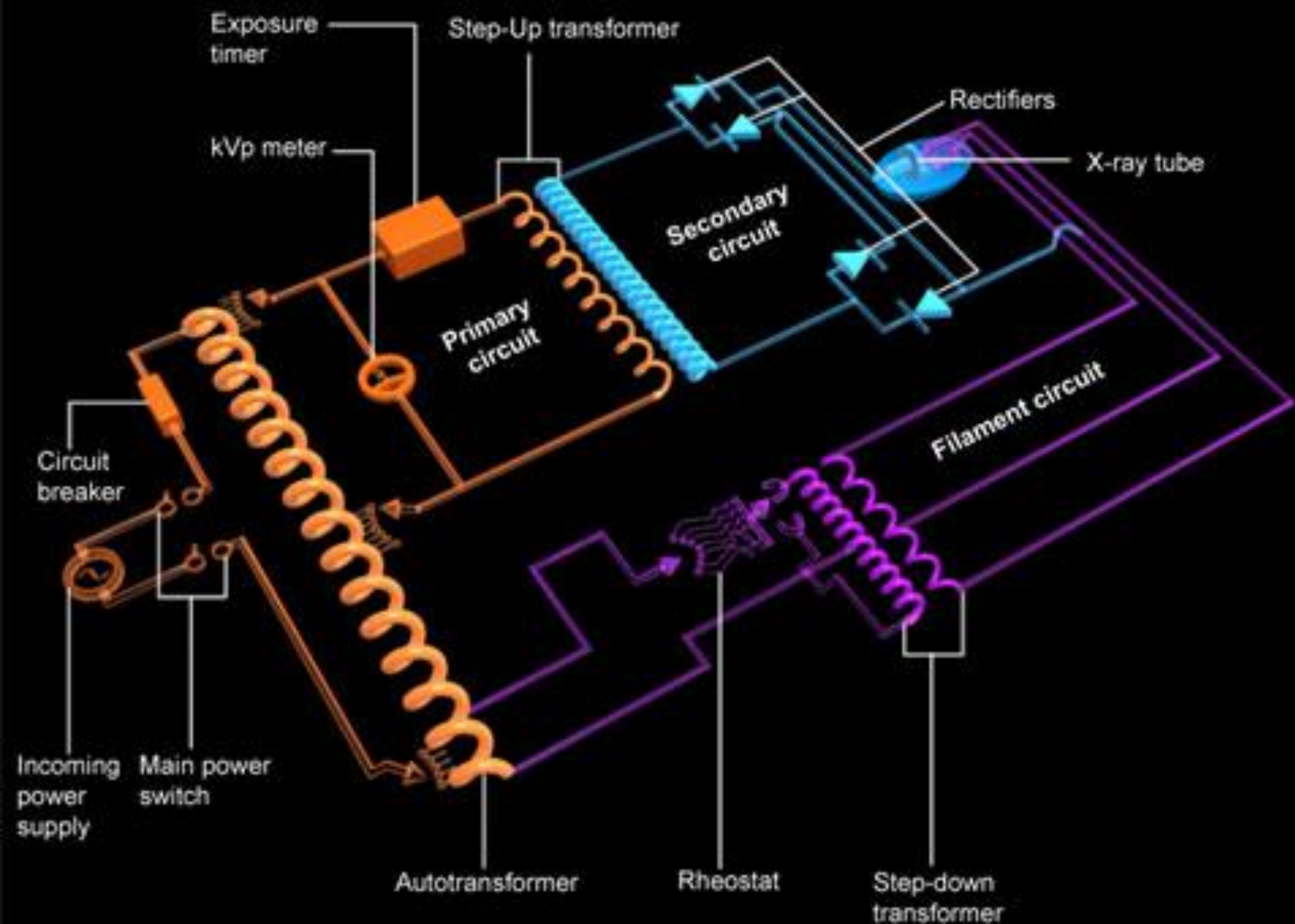
LESSON OBJECTIVES

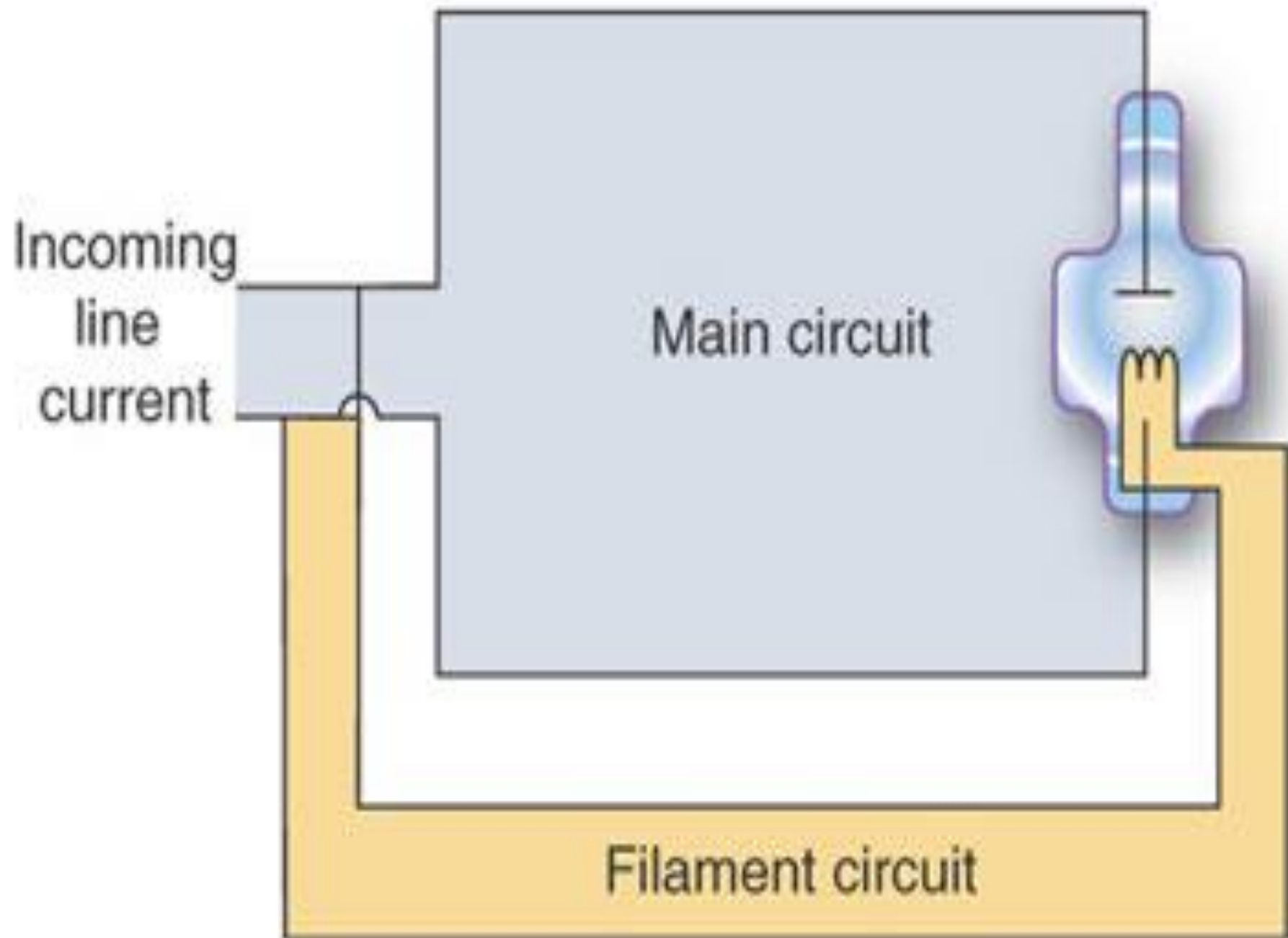
At the end of the lesson, the student should be able to:-

- Discuss the sequences of basic x-ray circuit.
- Describe the functions of the components.
- Explain the operational of components.



X-ray Circuit





BASIC X-RAY CIRCUIT

- The **main circuit** and **filament circuit** are combined to form the complete basic x-ray circuit that is composed of sequence of devices to produce x-rays.



X-RAY CIRCUITS

Main Circuit

1. **PRIMARY CIRCUIT** – Control Panel
 - **Main Switch:** The switch that generates the power to the x-ray tube.
 - **Exposure Switch:** A remote control device that permits current to flow through the circuit.
 - **Timer:** Device used to end the exposure at an accurately measured preset time.
2. **SECONDARY CIRCUIT** – high voltage transformers, rectification & x-ray tube.

Filament Circuit

1. **FILAMENT CIRCUIT** – varies current sent to the filament in order to provide the required mA value.



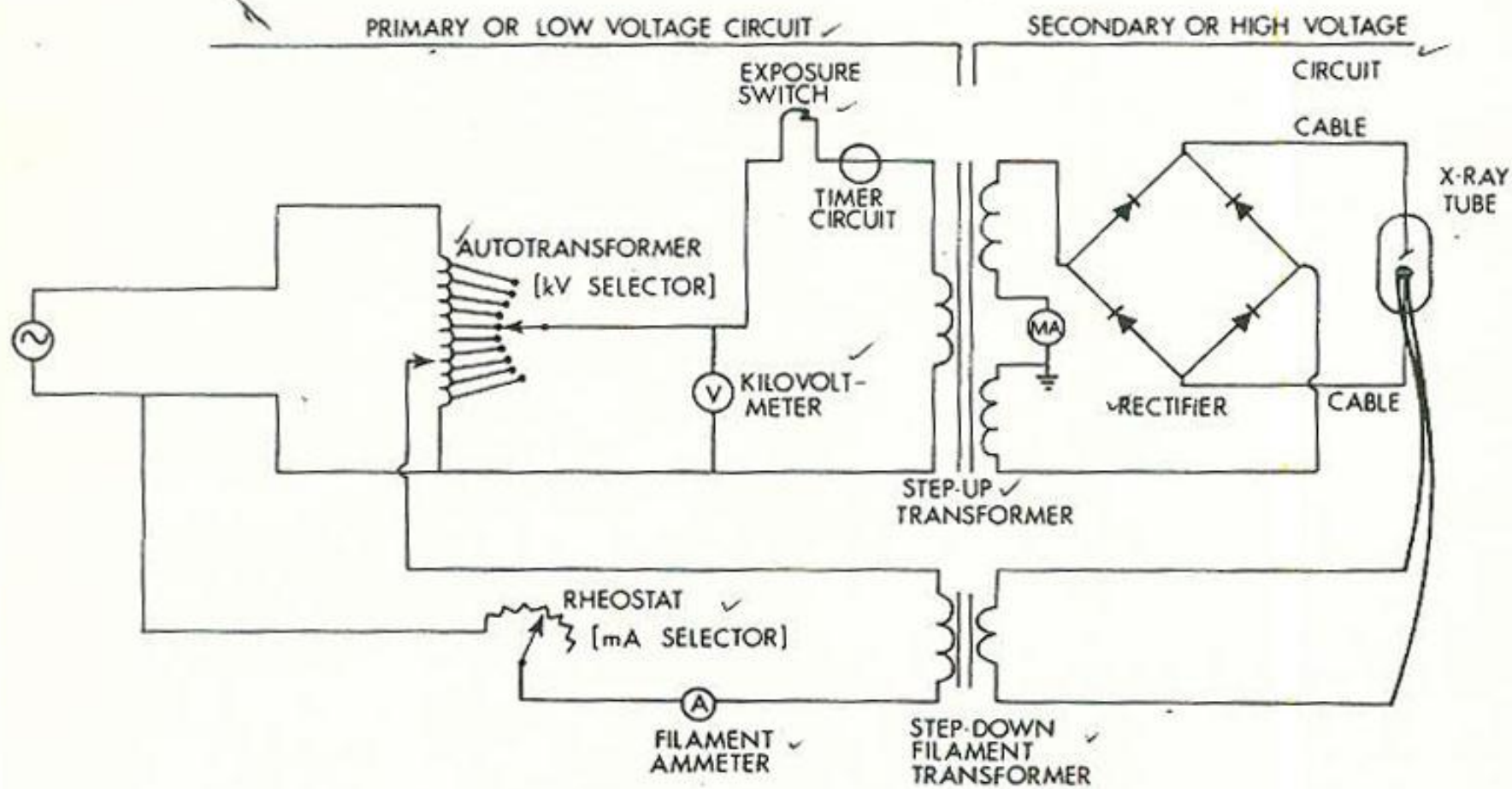


Figure 14.12. Simplified wiring of a single phase x-ray unit, with full-wave rectification.

MAIN CIRCUIT

- Supplies power to the x-ray tube so that x-rays are produced.
- Modifies incoming current to produce x-rays.
- Boost the voltage to the necessary range of x-ray production.
- Permit the radiographer to adjust technical factors.
- Incorporate appropriate circuitry to increase x-ray production efficiency.



FILAMENT CIRCUIT

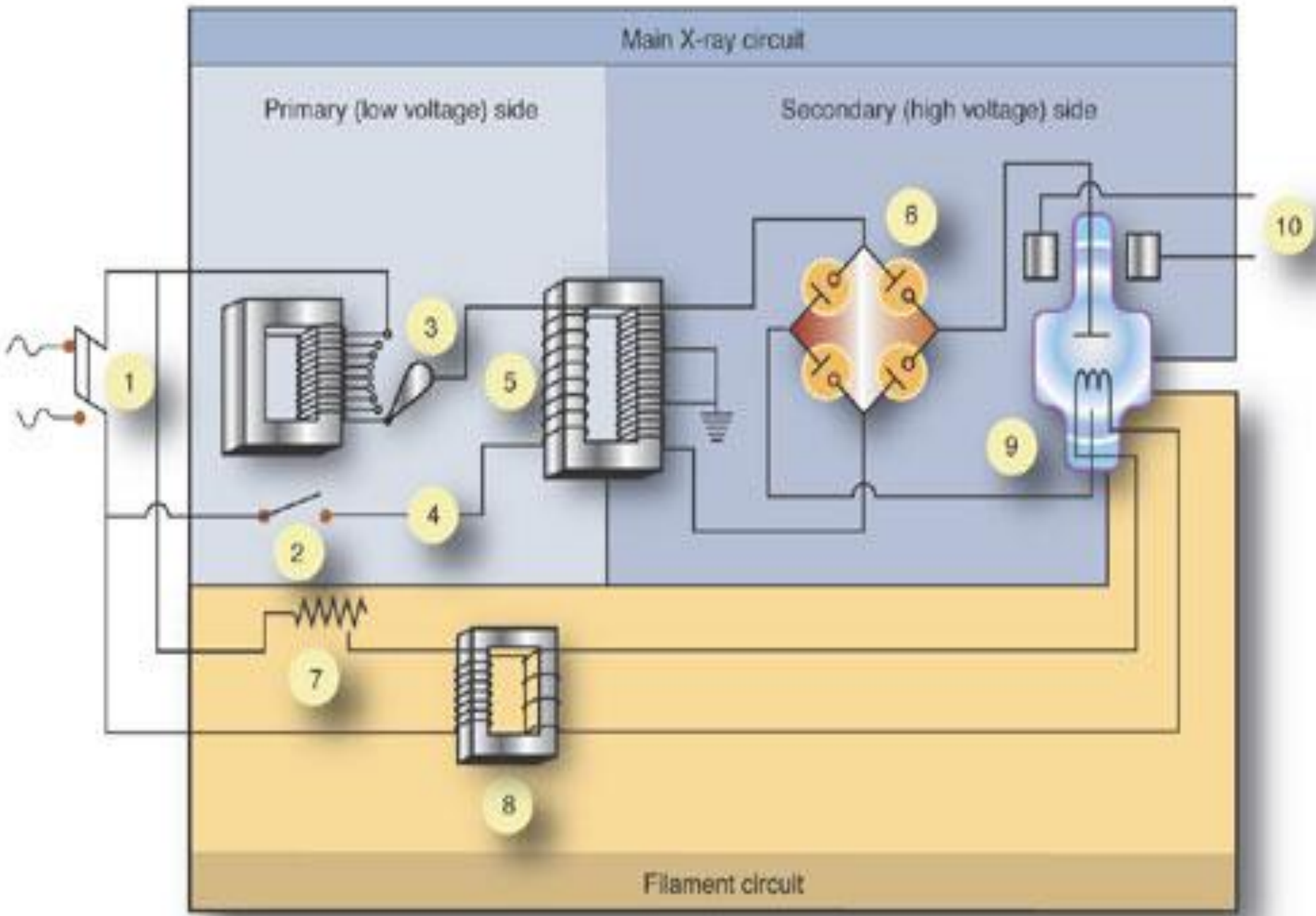
- supplies power to the filament of the x-ray tube so that the filament supplies enough electrons by thermionic emission.
- Modifies incoming line power to produce thermionic emission from the filament wire.
- Filament circuit adjusts to mA ratings (50, 100, 200, etc.)
- After mA selection, current sent to step down transformer to modify amps that reach.



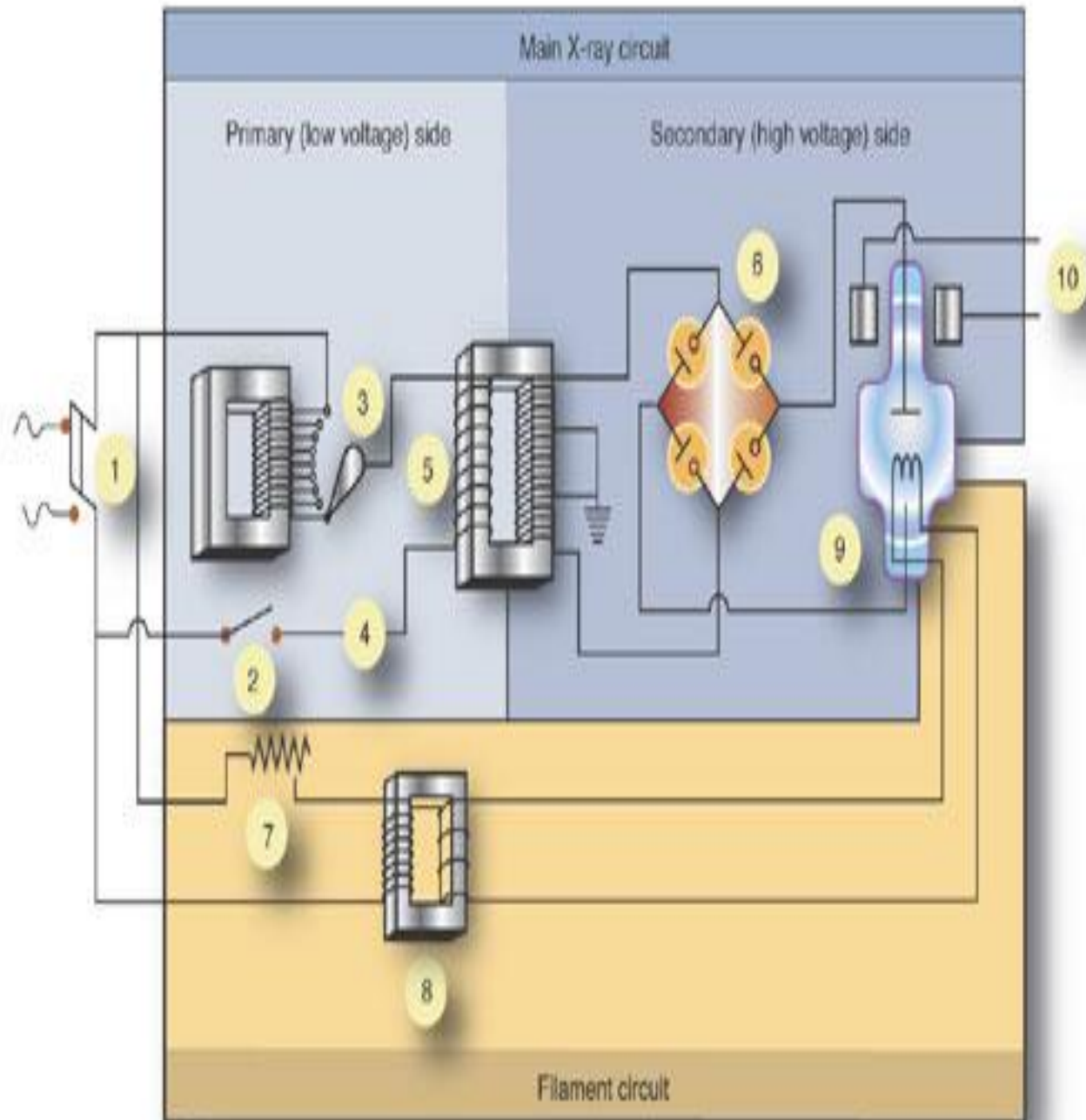
COMMON DIAGNOSTIC X-RAY CONTROL CONSOLE/PANEL

Control	Factor	Electrical Device and Location in Circuit
kVp Selection	kVp Level	Autotransformer (between incoming line and exposure switch)
mA Selection	Filament Current	Variable resistor (in filament circuit between incoming line and step-down transformer)
Time Selection	Length of exposure	Timer circuit (between exposure switch and step-up transformer)
Rotor Switch	Speed of rotating anode	Stator (separate circuit from stator of anode motor)
Exposure Switch	Moment of exposure	Switch (between autotransformer and timer circuit)





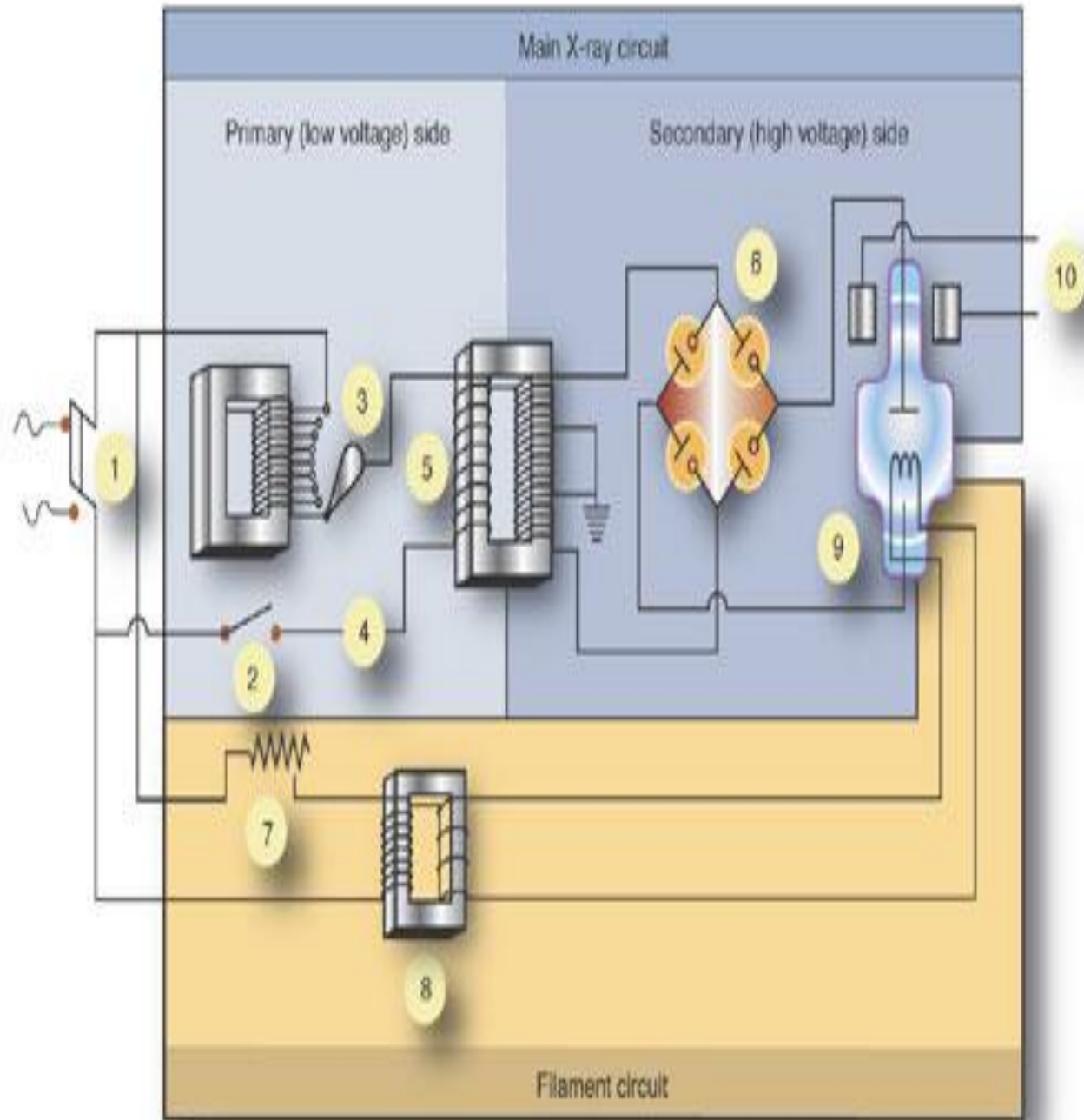
- 1. main breaker** - this is where the alternating current comes from to power the circuit.
- 2. exposure switch** - when you push the button to start an exposure this switch closes to start the exposure.
- 3. autotransformer** - this is where you adjust the kVp for the exposure.



4. **timer circuit** - this part of the circuit stops the exposure.

5. **high-voltage step-up transformer** - this transformer bumps the voltage up so that the x-ray tube has very high voltage to make the electrons have enough energy to form x-rays.

6. **four-diode rectification circuit** - this makes the current only go in one direction through the x-ray tube.

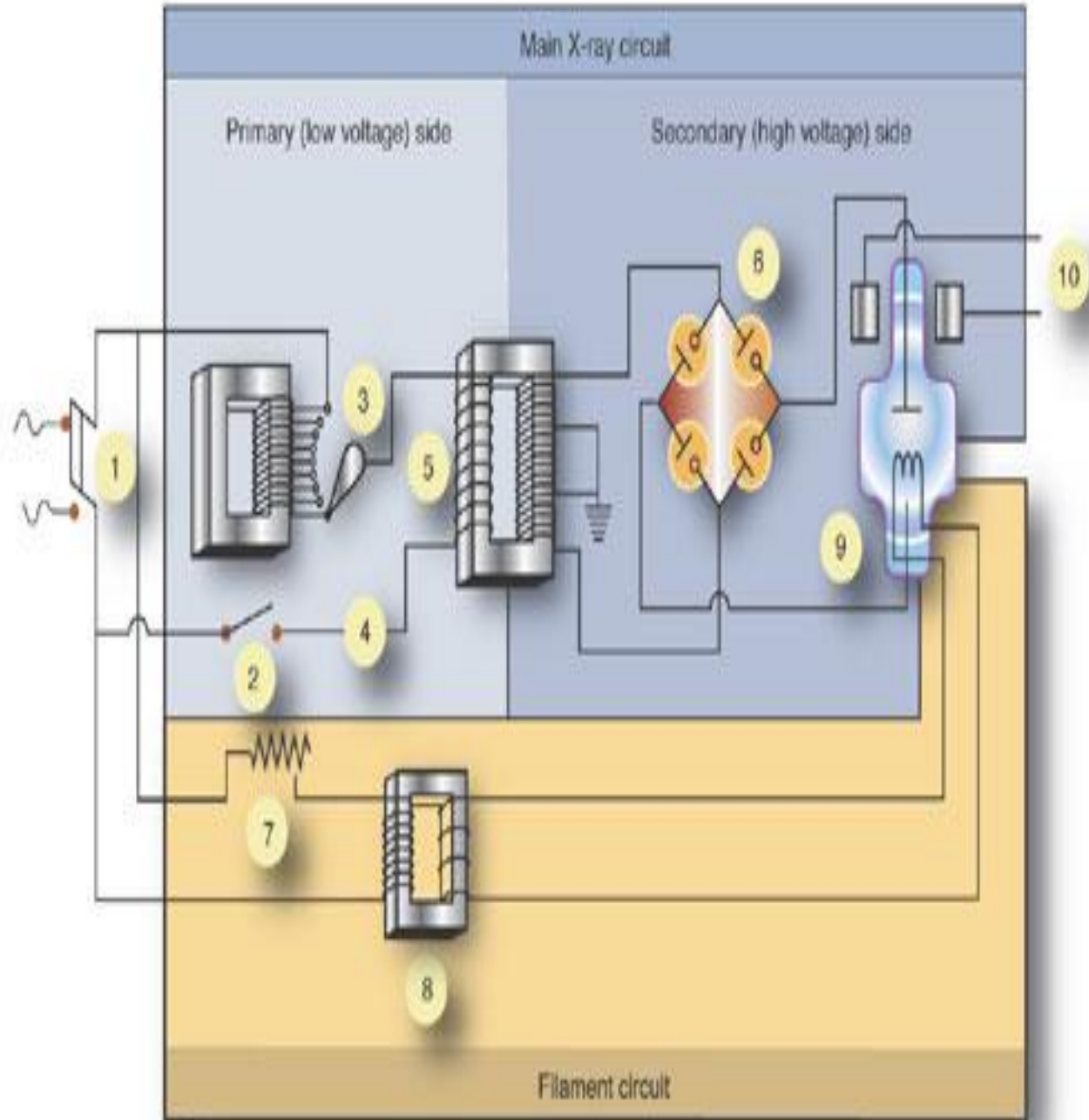


7. filament circuit variable resistor - this variable resistor adjusts the current going to the filament.

8. filament step-down transformer - this transformer steps the voltage down and therefore the current up.

9. x-ray tube - this is where the x-rays are created.

10. rotor stator - this rotates the anode.



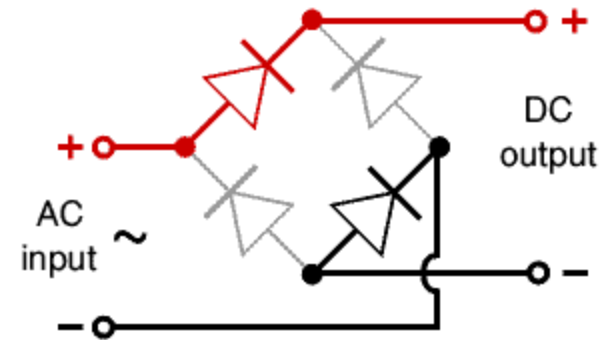
TRANSFORMERS

- **Autotransformer** - That contains an iron core and a single winding or wire; is used in the x-ray circuit to provide a small increase in voltage before the step up transformer.
- **Step-up transformer** - that increases voltage from primary to the secondary coil and decreases current in the same proportion. Has more turns in secondary than in primary coil. Is used to increase voltage to the kilo voltage level for x-ray production.
- **Step-down transformer** - that decreases voltage from primary to the secondary coil and increases current in the same proportion. Has more turns in the primary than in the secondary coil. Is used in the filament portion to increase current flow to the cathode.



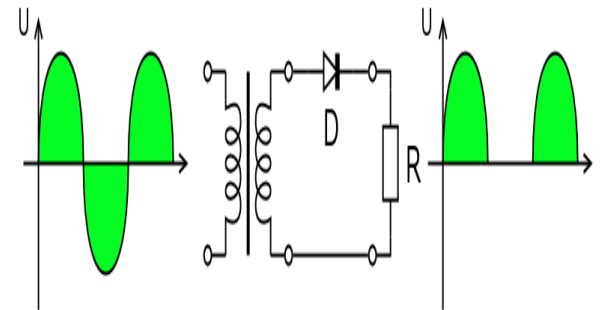
RECTIFIERS

- A rectifier is an electrical device that converts alternating current (AC) to direct pulsating current (DC).



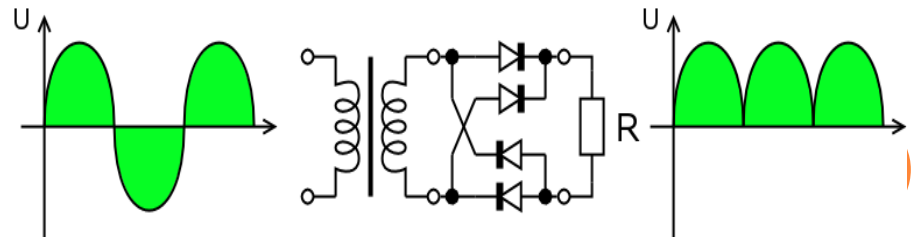
- Two Types of Rectifiers:
 1. **Half Wave Rectifiers**

* pass half of the alternating electrical current through one or more diodes



2. **Full Wave Rectifiers**

* generally use four diodes to function, changing the entire current into a direct current.



TIMER

- Used to regulate the duration of the x-ray exposure.
- Electronic timers are the most common timers used.
- They operate by charging a silicon- controlled rectifier which triggers the exposure
- The exposure times are calculated within 0.001 seconds with only a 1msec delay.



- Now let's see the video...

