

The X-ray circuit: part II

By

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357 Radiologic Processing & Procedure

Lecture notes #2

Key issues

- **Types of x-ray equipment.**
- **Power for x-ray generator.**
- **A basic x-ray circuit.**
- **Generators.**

Types of x-ray equipment

- **Medical x-ray units can be classified as????**
- Medical x-ray units can be classified as **diagnostic** or **therapeutic** .
- **Diagnostic units:**
 1. Designed for specific procedures, such as general procedures, fluoroscopy, head procedures, cardiac catheterization, etc.
 2. All of these units operate within the diagnostic range (10-1200 mA, 0.001-10 s, and 25-150 kVp).
 3. Can be classified as fixed units or portable units.

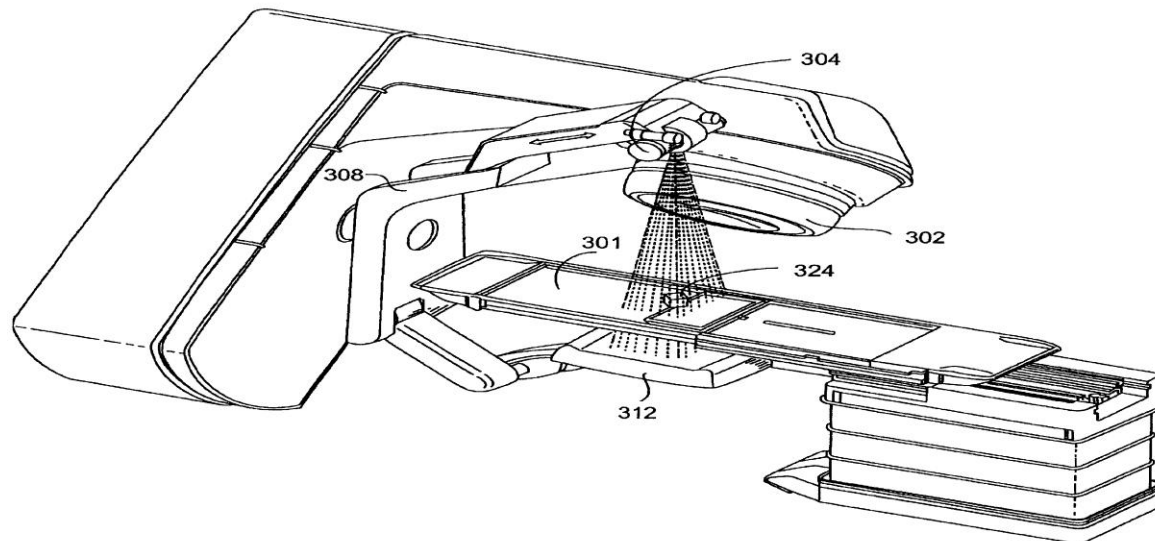
Types of x-ray equipment



Types of x-ray equipment

- **Therapeutic units:**

1. Operate at much higher energies, ranging from 4-40 million electron-volts (meV).
2. For that they operate at low mA ranging below 20 mA and with time settings in the range of 1-60 minutes.



Types of x-ray equipment

- **X-ray tables:**
 - The radiographic table is designed to support the patient in a position that will enhance radiographic procedure.
 - Foam pads may be used for lengthy examination to offer comfort.
 - The tabletop must be uniformly radiolucent. Why?
 - To easily permit x-rays to pass through.
 - The tables are commonly made of bakelite or similar surface except for specialized procedures as such angiography, carbon graphite fiber is used to reduce absorption of photons.

Types of x-ray equipment

- **X-ray tables:**
 - Most x-ray tables have flat tops shaped and some have curved tops. Why?
 - Curved tops are used for fluoroscopic procedures because they are more comfortable for the patients and allow the body part to be closer to the x-ray film. Any problems?
 - They are considered difficult to maintain a patient accurately in an oblique or lateral position.
 - The table must include space for a tray to hold film cassettes and a radiographic grid.

Types of x-ray equipment

- **X-ray tables:**
 - The tray is often called?.....
 - Many tables include automatic exposure control sensors in the tray and some use a stationary tray with a movable tabletop.
 - Tables are available in fixed and tilting models. Why?
 - Fixed: Do not permit tilting patient's head or feet. They are designed for radiographic work only.
 - Tilting: They permit tilting up to 90 degrees used mainly for fluoroscopic procedures.

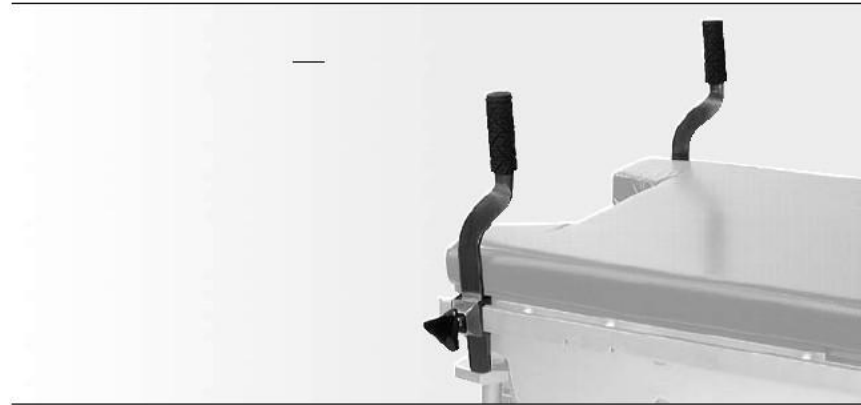
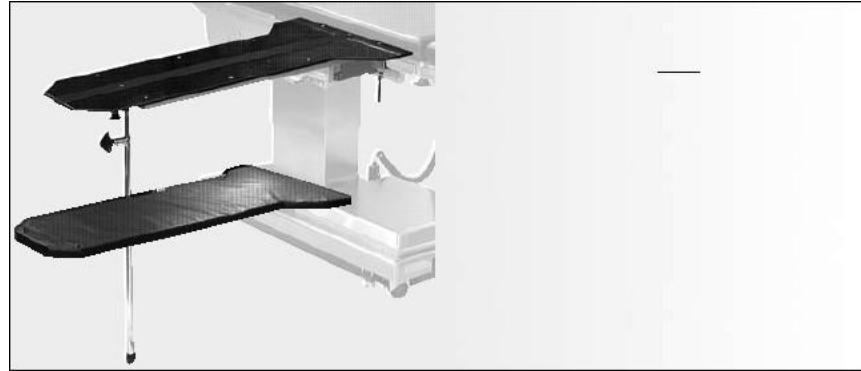
Types of x-ray equipment

- Tilting tables include a footboard for patients to stand on when the table is upright. Why?
 - The footboard is often used for gastrointestinal studies when the patient begins examination in a horizontal position.
- Some procedures such as myelography require the patient to be tilted head down. This requires the use of shoulder supports.
 - **Handgrips** give the patient an added feeling of security.

Types of x-ray equipment



Types of x-ray equipment

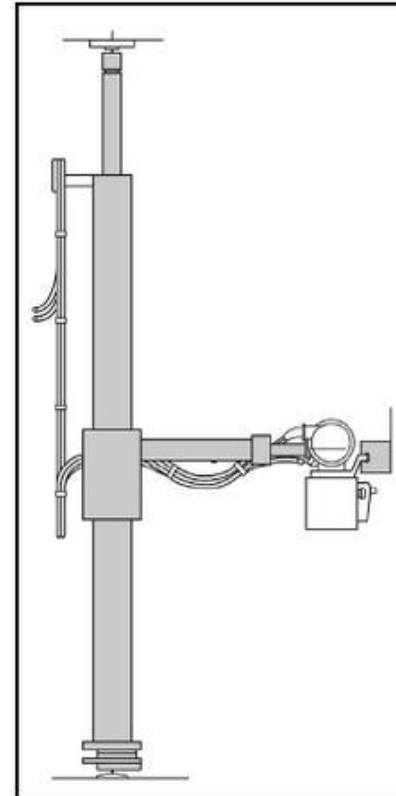


Types of x-ray equipment

- **Tube supports:**
 - They are designed to permit the x-ray tube to be manipulated and hold the tube immobile during exposure.
 - Tube suspensions are available in five versions: **overhead, floor-to-ceiling, floor, mobile & C-arm.**
 - **Overhead suspension system** can be angled up to 300° arc around the tube column. Different angles can be locked into place by?
 - Different manufacturers have various types of locks and detents.

Types of x-ray equipment

- **The floor-to-ceiling system** is mainly used for skull procedures and chest.
- The main disadvantage of this system is difficulty of tube manipulation.



Types of x-ray equipment

- **Head unit:** is a specialized adaptation of the floor-to-ceiling unit and is designed to enhance radiography of the cranium (skull) and facial bones. Any advantages?
 - It improves head radiography by regulating tube angles, decreasing the distance from the patient to the film and minimizing time to position the patient.



Types of x-ray equipment

- **Upright units:** they are upright film cassette holder or Bucky used mainly for chest radiography. What else?
 - They are also used for some skull radiographic procedures such as acromioclavicular joints, abdominal obstructive procedures, cervical spine, etc.



Power for x-ray generation

- The production of x-ray photons within an x-ray tube requires accelerating electrons capable of producing necessary speed. **Where does that come from?**
- A diagnostic x-ray generator is composed of numerous basic electrical devices that are connected in a sequence capable of this speedy electrons production.
- The power producing electricity to the x-ray generator is known as **incoming line current** and is supplied in the form of a three-phase power cycle.
- Nearly all x-ray equipment operates from an incoming line of 210-220 volts.

A basic x-ray circuit

- The basic x-ray circuit can be divided into???
- 1. **The main circuit.**
- 2. **The filament circuit.**
- **The main circuit:** it supplies the x-ray tube with properly modified power.
- Its purpose is to produce x-rays.
- The main circuit has 3 major functions:
 1. Boost the voltage to the necessary range of x-ray production.
 2. Permit the radiographer to adjust technical factors.
 3. Incorporate appropriate circuitry to increase x-ray production efficiency.

A basic x-ray circuit

- A sequence of devices modifies the incoming line power to produce x-rays including: **main breaker, exposure switch, autotransformer, timer circuit, high-voltage step-up transformer, four-diode rectification circuit, filament circuit, filament step-down transformer, x-ray tube and rotor stator.**
- The main switch and **main breaker** are enclosed in an electrical power box.
- The **exposure switch** acts like a remote control, allowing current to flow through the circuit.
 - It only allows the exposure to begin and not end.
- It must be of the “dead man” type? Meaning and why?...

A basic x-ray circuit

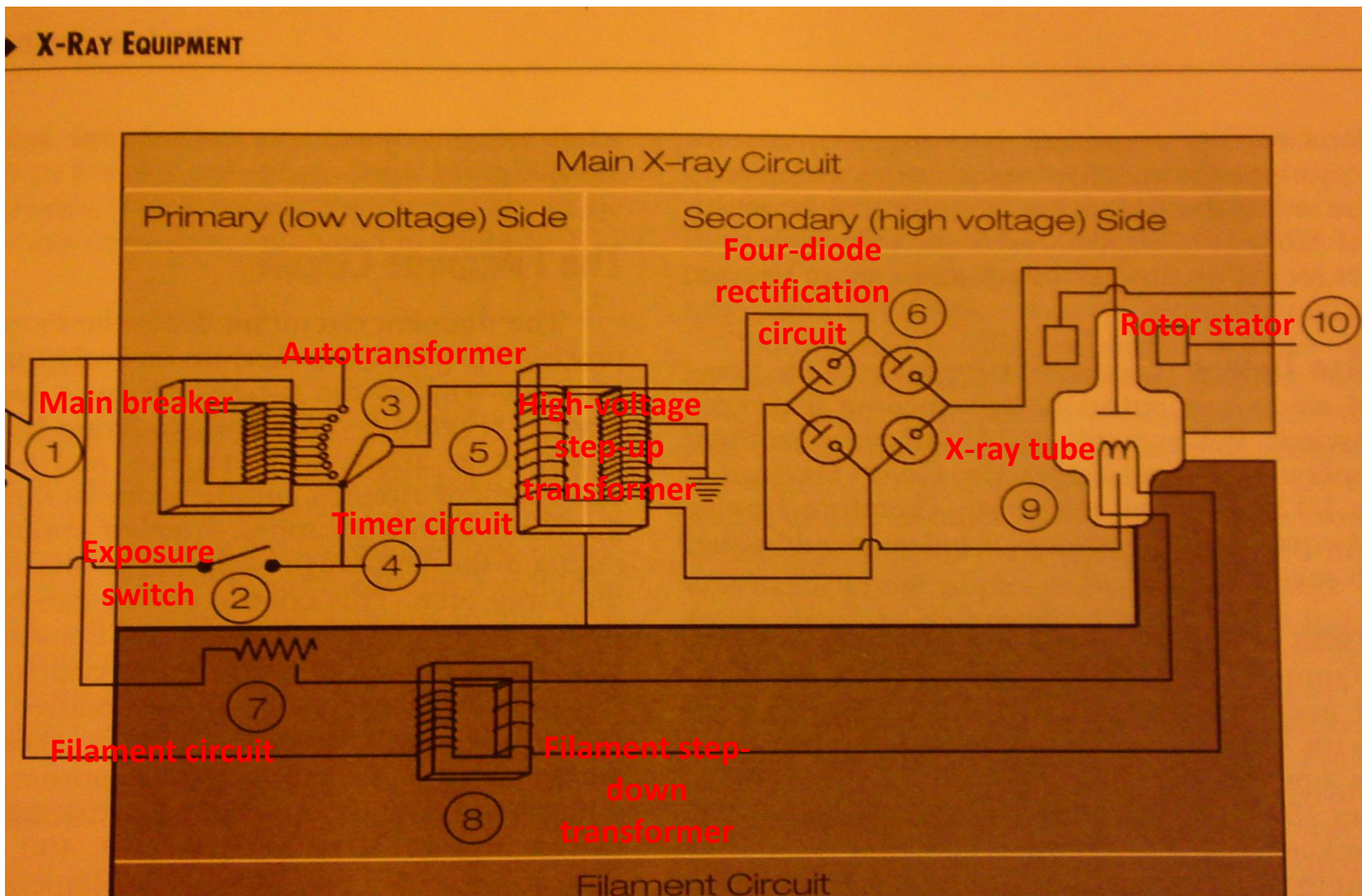
- The **timer circuit** is designed to end the exposure at accurately measured time.
- The timer circuit can be of several types including: mechanical timers (not very accurate and capable of exposure only to 0.25 second), synchronous timers (can not be used for serial exposures), impulse timers, electronic timers (most common timers and capable of exposures as short as 0.001 second), and milliamperere-second timers.
- Automatic exposure controls are used and will be discussed in later lectures.

A basic x-ray circuit

- The **filament circuit** supplies the filament of the x-ray tube with properly modified power.
 - Its main purpose is to create the appropriate thermioically emitted electron cloud at the filament.
- **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.**

A basic x-ray circuit

- The complete basic x-ray circuit & its components:



A basic x-ray circuit

- The operating console has common diagnostic controls:

TABLE 5-1. Common Diagnostic X-Ray Console Controls

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)

Generators

- Post holiday gift.....
- Briefly explain the difference between single-phase generators and three-phase generators.

Have a great day

