Theoretical Lecture

Operating Console: Line Compensation, Autotransformer

Operating Console

The part of the x-ray imaging system most familiar to the radiologic technologist is the operating console. The operating console allows the radiologic technologist to control the x-ray tube current and voltage so that the useful x-ray beam is of proper quantity and quality (figure1).

Figure1: operating console.

Radiation quantity refers to the number of x-rays or the intensity of the x-ray beam. Radiation quantity is usually expressed in milliroentgens (mR) or milliroentgens/milliampere-second (mR/mAs).

Radiation quality refers to the penetrability of the x-ray beam and is expressed in kilovolt peak (kVp).

The operating console usually provides for control of line compensation, kVp, mA, and exposure time as in figure 2.

Meters are provided for monitoring kVp, mA, and exposure time. Some consoles also provide a meter for mAs. Imaging systems that incorporate automatic exposure control (AEC) may have separate controls for mAs.

Most operating consoles are based on computer technology. Controls and meters are digital, and techniques are selected with a touch screen.

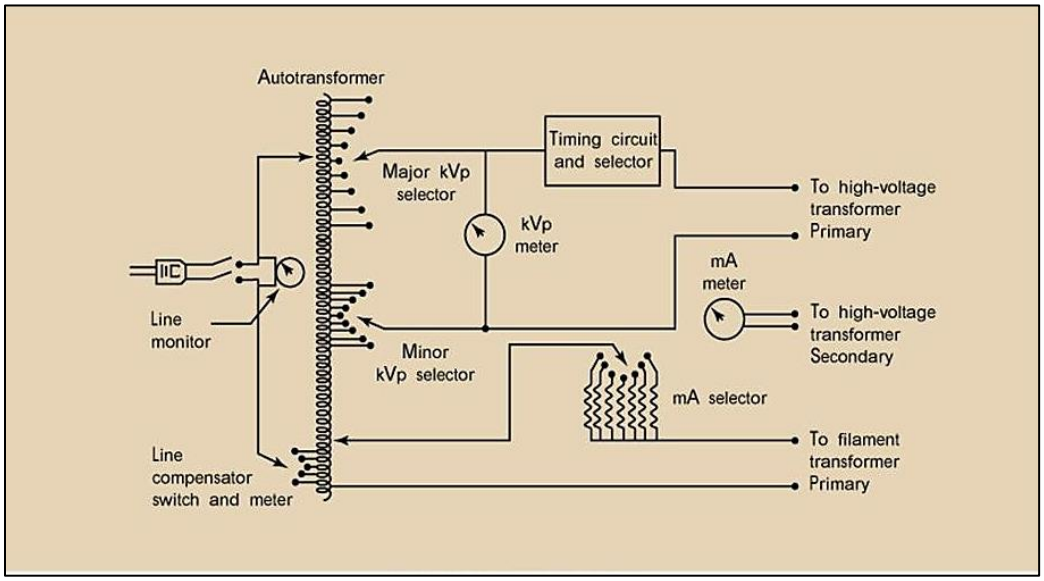

Figure2: console circuit.

Line Compensation

The **line compensator**: Physical component that stabilises the voltage input and measures the voltage provided to the x-ray imaging system and adjusts that voltage to precisely 220 V. Older units required technologists to adjust the supply voltage while observing a line voltage meter. Today's x-ray imaging systems have automatic line compensation and hence have no meter (figure 3).

- Measures the voltage input continuously
- adjusts the required voltage accordingly
- stabilises input fluctuation

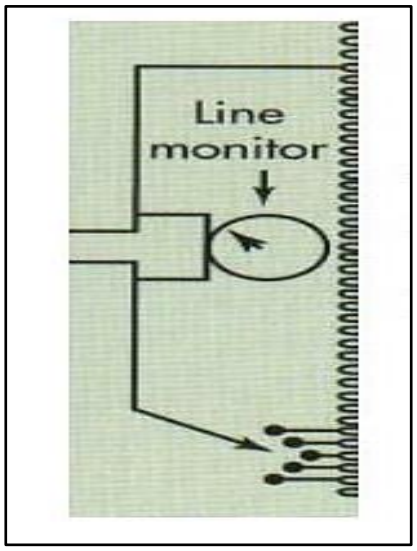

Figure 3: line compensator.

Most machine are designed to operate at 220 volts while some will work with 110 volts or 440 volts. The power company often cannot provide exactly 220 volts at all times. Because of variations in power distribution to the hospital and in power consumption by the various sections of the hospital, the voltage to the x-ray unit may vary by 5%, which will result in large variations in x-ray output.

Effect of voltage fluctuation:

- Variation radiation output
- Quality
- Quantity

Autotransformer

- Receives power from the line compensator and provides power to the high voltage and filament circuits.
- Responsible for power for the filament circuit/mA selection

The power supplied to the x-ray imaging system is delivered first to the autotransformer. The voltage supplied from the autotransformer to the high-

voltage transformer is controlled but variable. It is much safer and easier to control a low voltage and then increase it than to increase a low voltage to the kilovolt level and then control its magnitude.

Autotransformer design

The *autotransformer* works on the principle of electromagnetic induction (self-induction), but is very different from the conventional transformer (figure 4).

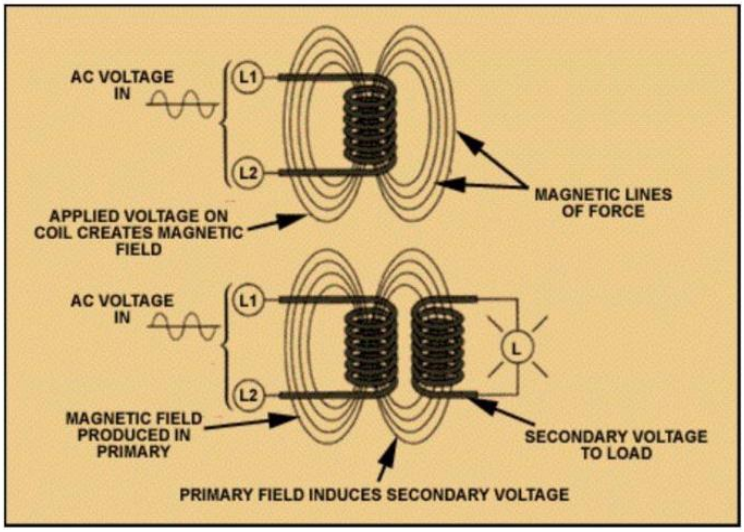

Figure 4: transformer with two windings.

Autotransformer has only one winding serves as both primary and secondary benefits and also one core. This single winding has a number of connections along its length (figure 5).

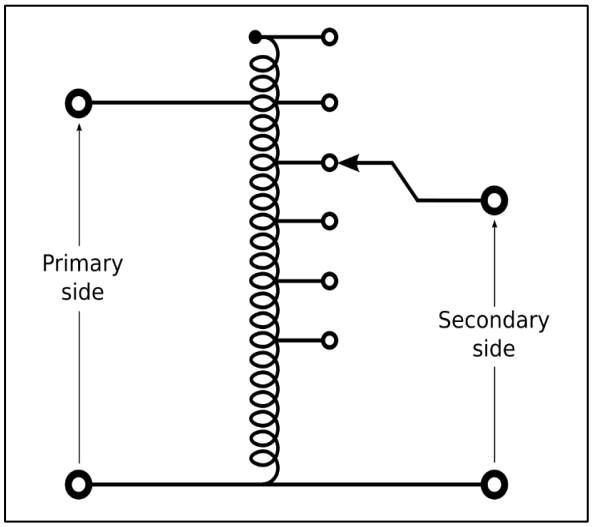

Figure 5: Autotransformer with on winding.

Autotransformer mechanism:

- Wires carrying input power from the line compensator connected to the 2 points of the winding of the autotransformer (primary connection)

- Another 2 points of the winding of the autotransformer are connected with the wires providing output to the other components (secondary connection). Figure 2 shows the console circuit.
- The purpose to use the Autotransformer is to overcome induction losses. Its value ranges from 0 to 400V.

Questions:

1. What is the work of line compensator? With drawing?
2. Draw the autotransformer and explain the principle of work of it?
3. Compare the diagram between transformer and autotransformer?
4. What is the mechanism of autotransformer?