

LIGHTING CIRCUITS**4.1. INTRODUCTION**

In lighting circuits, besides the necessary wiring for carrying the electrical energy, there are used three main terminal devices: lamps, receptacles and switches. One of the most important advantages of electrical power is that the user can easily control it. This can be done thanks to the switches. There are many types of switches, ranging from the simple element, manually operated that open or close a circuit, to sophisticated electronic devices that respond to signals from sensors or other sources.

This chapter will deal with the principal characteristics of switches and receptacles used in lighting circuits. As the circuits will be always single-phase, 3-wire circuits, the used colors for the conductors are as shown in Figure 4.1. The phase “hot” conductors are red or black; the neutral conductor is white, and the ground conductor green.

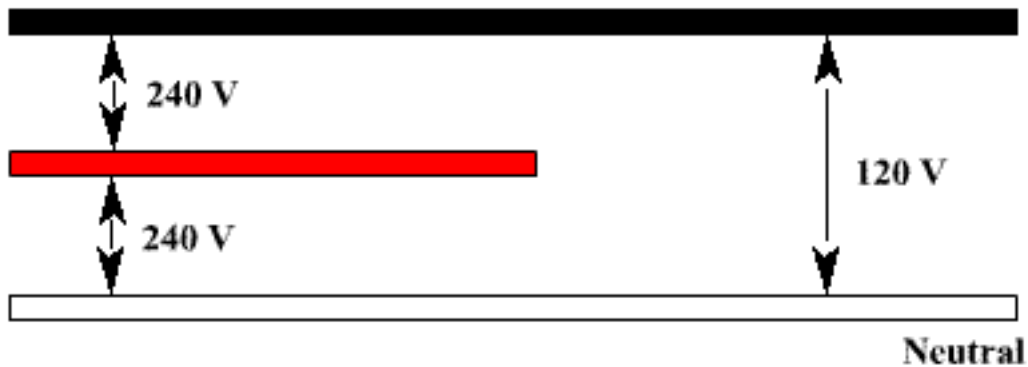


Figure 4.1. Single-phase, 3-wires circuits.

4.2. –SWITCHES

Because of their wide use, it is important to devote special attention to the switches characteristics and how they are to be connected into the electrical lighting circuit. The switches can be categorized as ac or ac-dc. The ac switches are used only in alternating current circuits and within the voltage and ampere rating indicated on the switch.

The number of wires in a circuit that the switch controls depends on the number of *poles* in the switch. They may be single-pole or multiple-pole. If the switch operates only in one position it is known as single-throw. Double throw switch is the one that operates in either of two positions. Figure 4.2 shows some typical switches.

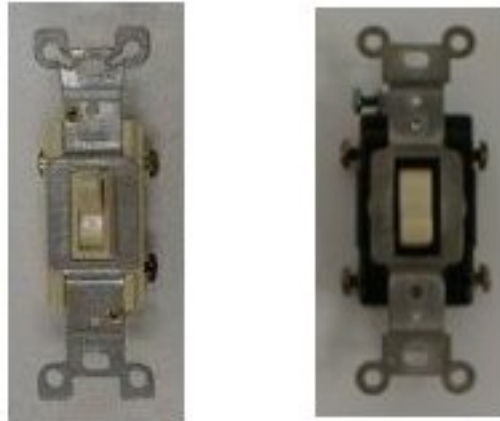


Figure 4.2. Switches

Single-pole switches are used widely, where one or more lights are to be controlled from one location, as shown in Figure 4.3. It is necessary to indicate here that switches are going to be connected always interrupting the phase conductors, never the neutral or ground conductors.

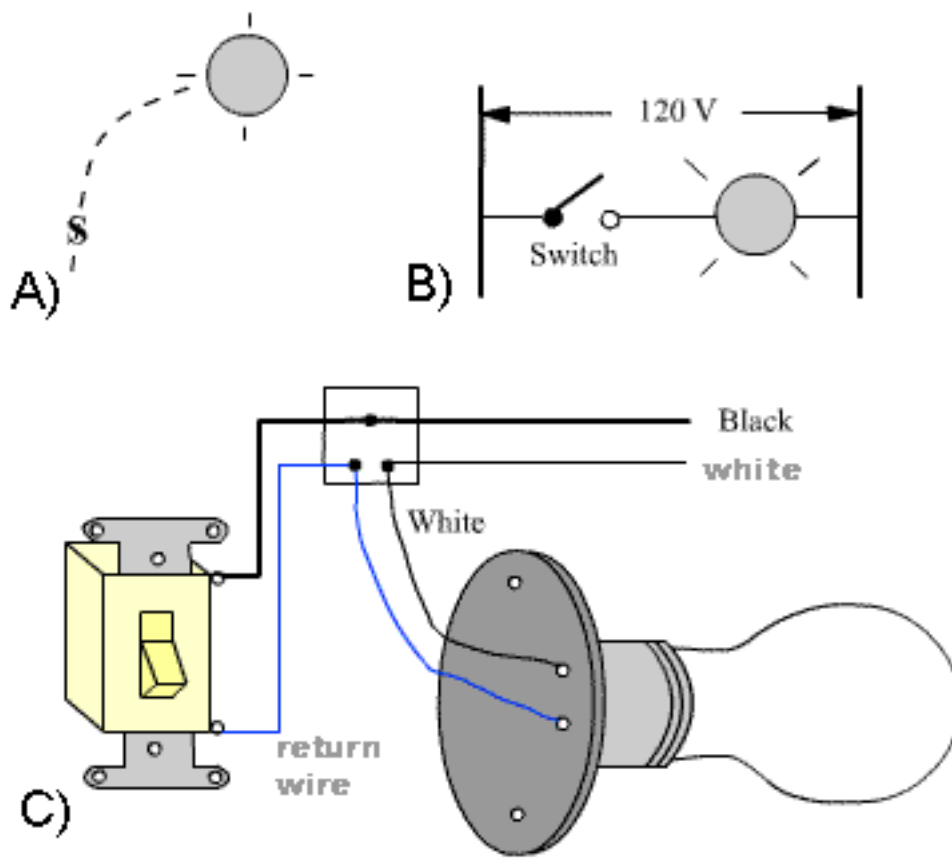


Figure 4.3. Single-pole switch controlling a light. A) Architectural plans, B) Schematic diagram, C) wiring diagram.

4.3. –RECEPTACLES

The differences in receptacles are based on ampacity and voltage rating of the device. The National Electrical Manufacturers Association (NEMA) has developed standards for the physical appearance of receptacles. Figure 4.4 shows two of the most commonly used receptacles.

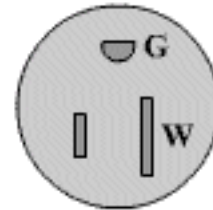
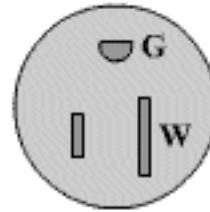
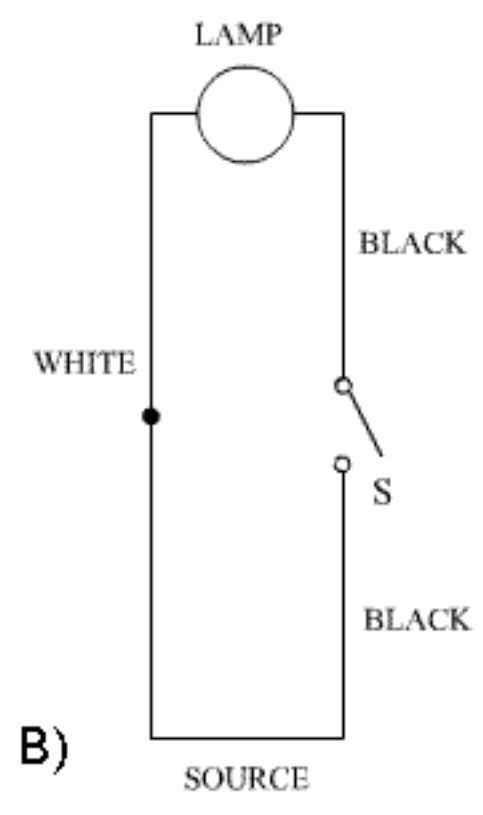
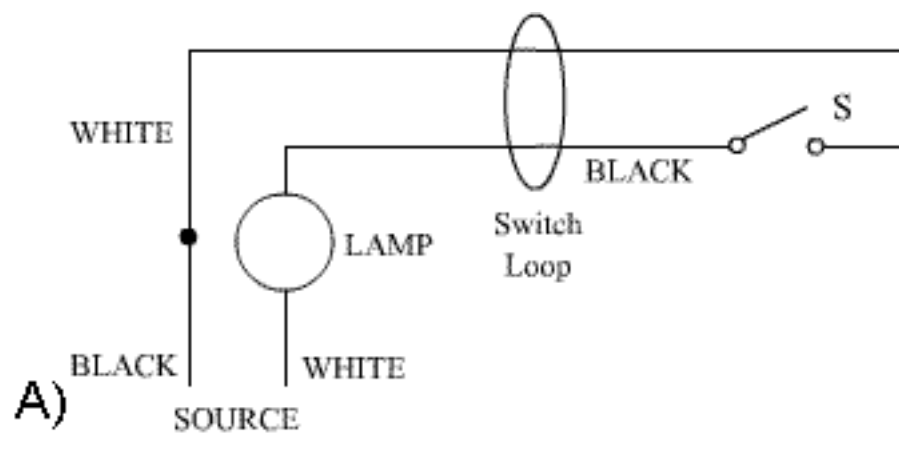


Figure 4.4. Receptacles. A) NEMA 5-15R, B) NEMA 5-20R

According to the NEMA terminal identification, the green colored terminal is to be connected to equipment grounding conductor only. The silver colored terminal is to be connected to the neutral (white) conductor, and the brass colored terminal is to be connected to the “hot” conductor. When connected through a switch, the brass colored terminal is connected to the “return” wire, which is the one that goes from the switch to the controlled device. The return wire color may be other than gray, green, red, or black. Figure 4.5 presents some typical lighting circuits.



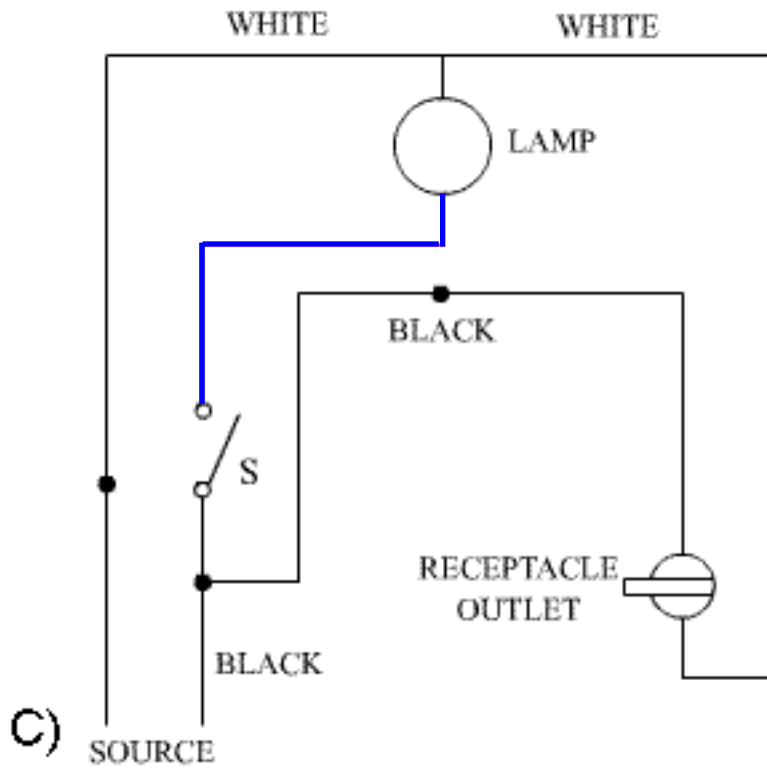
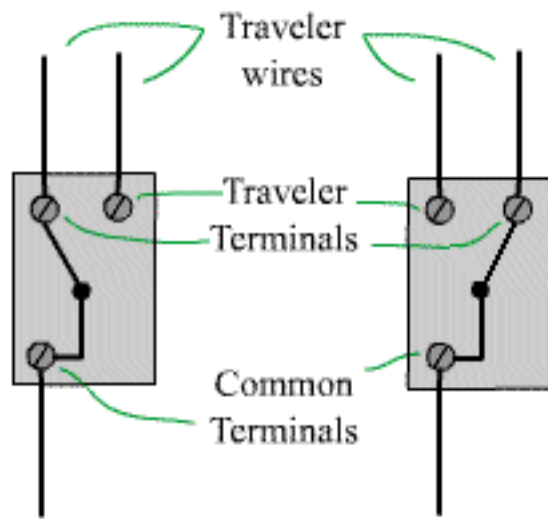


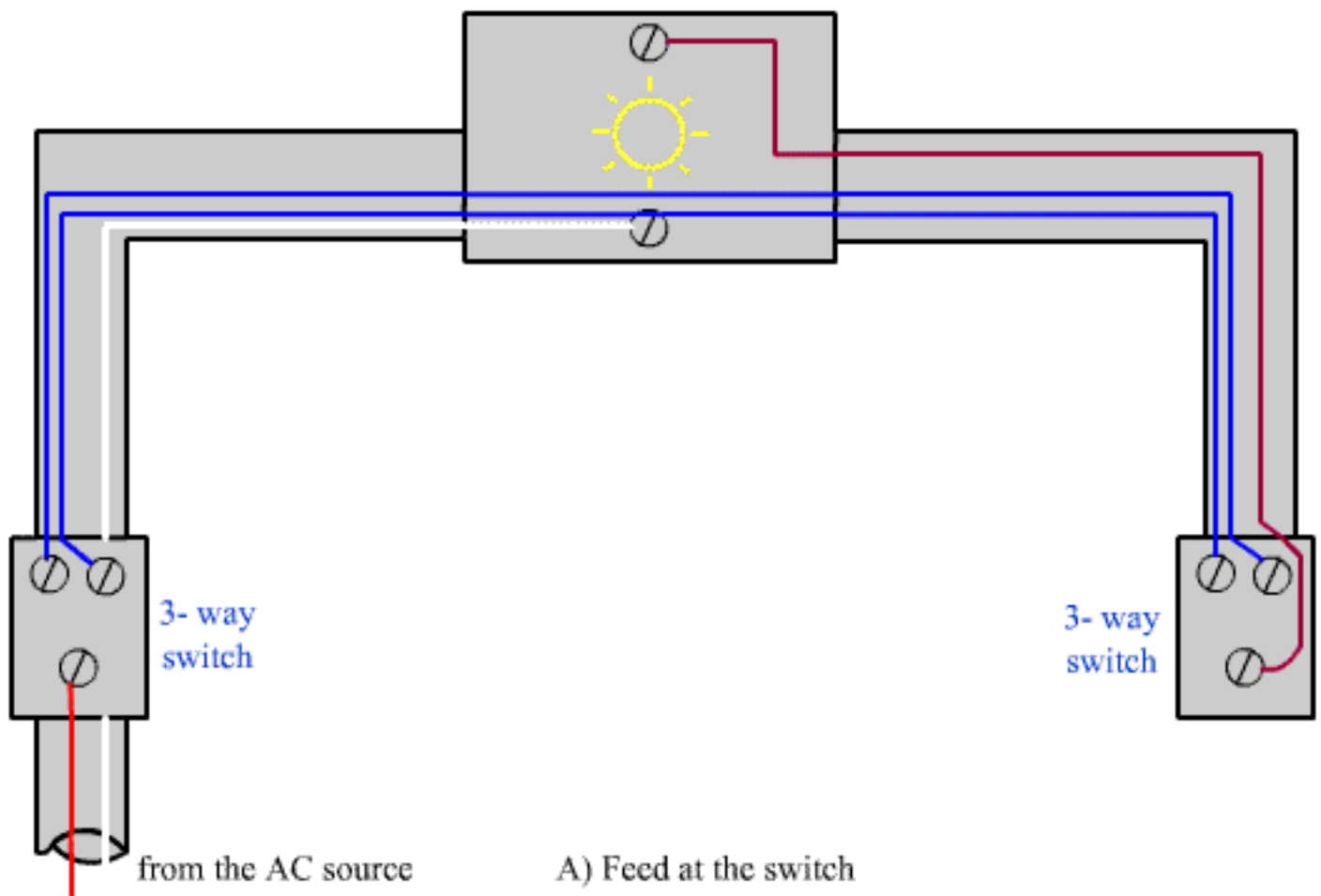
Figure 4.5. Typical lighting circuits. A) single pole circuit with feed at switch, B) single pole switch with feed at light, C) Ceiling outlet controlled by single-pole switch with live receptacle outlet and feed at switch.

4.4. –THREE -WAY SWITCHES

These switches are used for controlling lights from more than one location. A three-way switch has a common terminal to which the switchblade is always connected. The other two terminal are the traveler terminals (Figure 4.6). The way a three-way switch may be connected is shown in Figure 4.6.



Two positions of a three-way switch



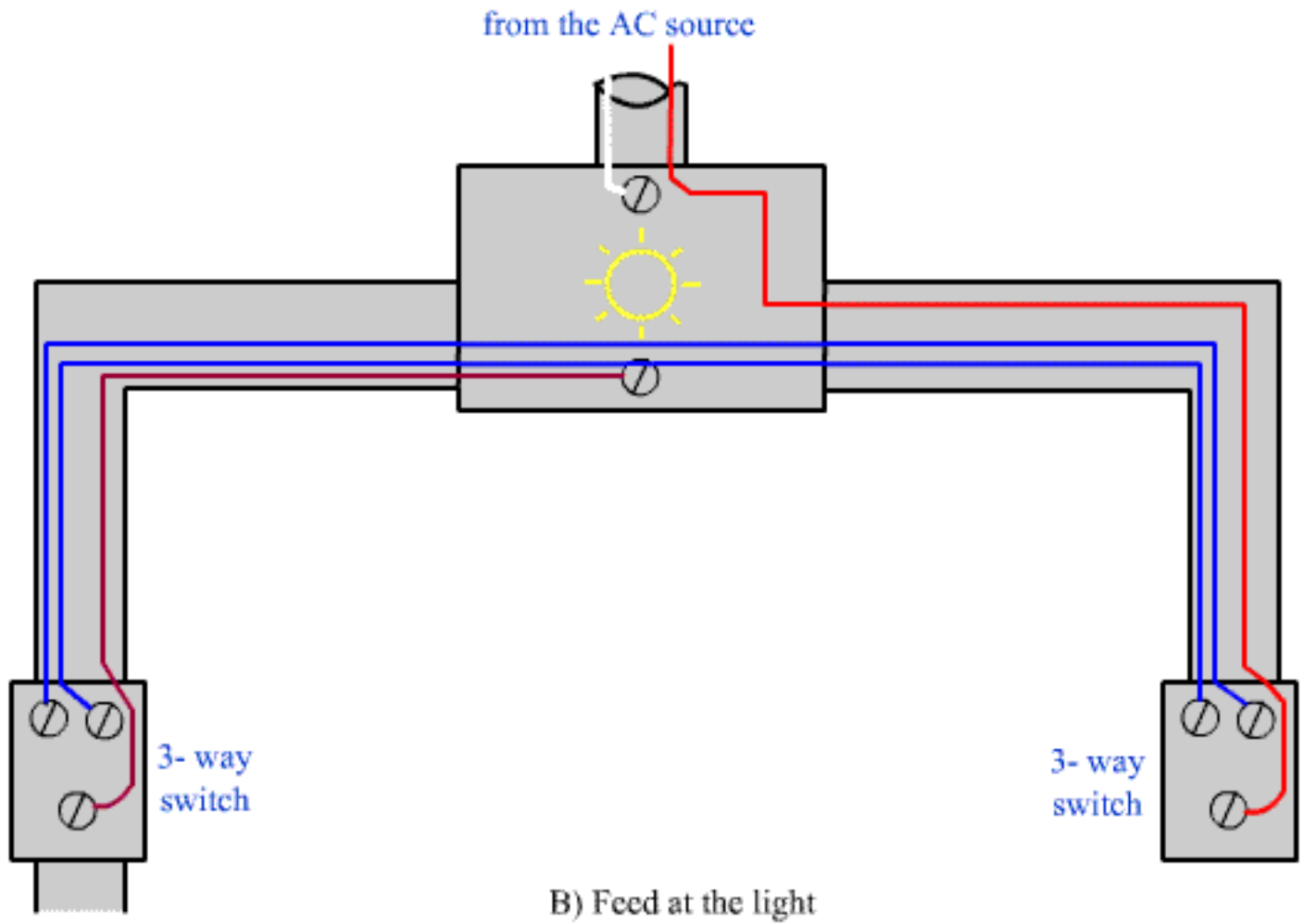


Figure 4.6. Three –way switch connections. A) feed at the switch, B) feed at the light

4.5. –FOUR-WAY SWITCHES

The four-way switches are employed when it is necessary to interrupt a circuit from more than two places. They are similar to the three-way switches in that they do not have On and Off positions, but they have four terminals, as can be seen in Figure 4.7.



Figure 4.7. Four-way Switch

The four terminals are connected to traveler wires from another four-way switch or from one three-way switch. Figure 4.8 shows the way the connection can be made. Never a four-way switch can be connected to the end of the switching circuit. At both ends a three-way switch will be installed.

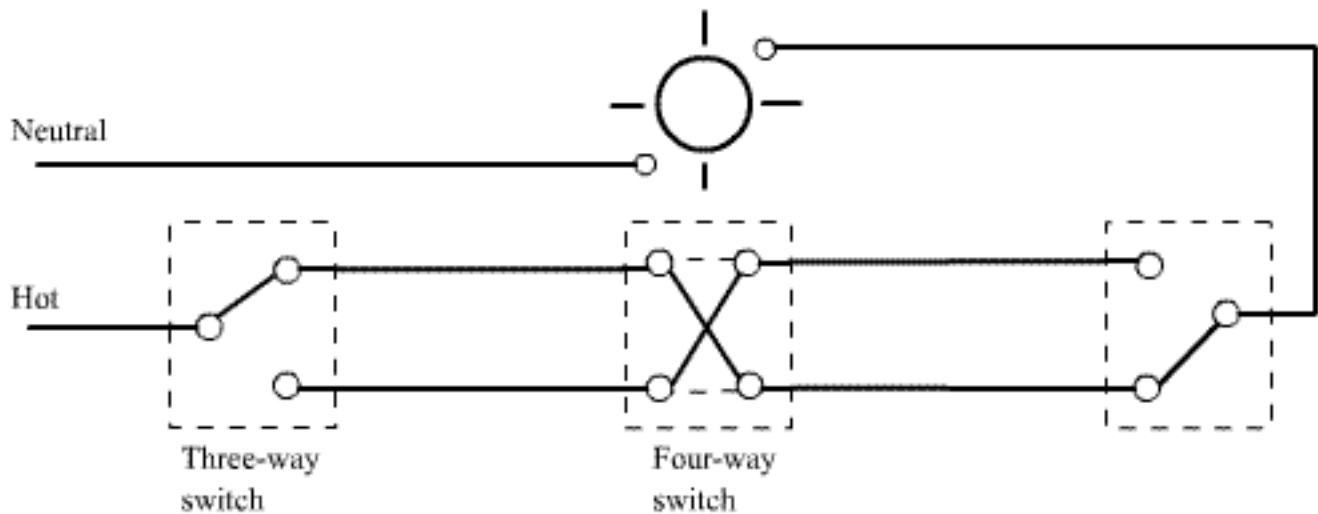


Figure 4.8. Four-way switch connections

4.6. –DOUBLE-POLE SWITCHES

A double-pole switch interrupts at the same time two-phase conductors. The major applications of these switches is when interrupting appliances like motors, water heaters, and others, connected to more than one phase conductor. It is rarely used in lighting circuits. In Figure 4.9 it is shown a possible application interrupting a motor connected to a 240 V source.

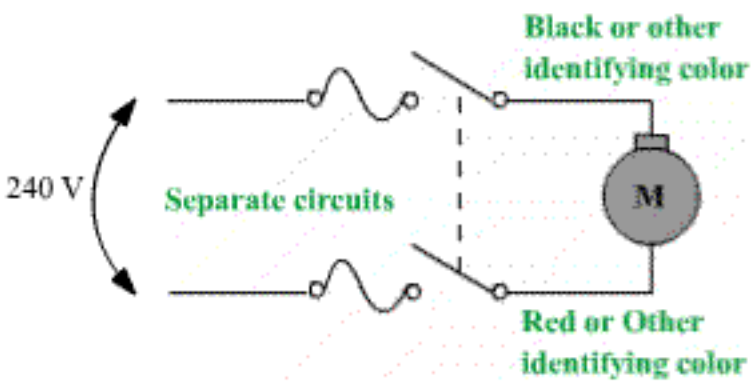


Figure 4.9. Double-pole switch interrupting a 240 volts motor load

4.7. –MISCELLANEOUS TYPES OF SWITCHES

There exist a wide range of specialized switches for different applications. Some examples are:

Switch with pilot light. Used when it is desired to have signalization of the load state directly on the switch. Are common in situations where the load is not in sight of the switch location. An example of connection is shown in Figure 4.10.

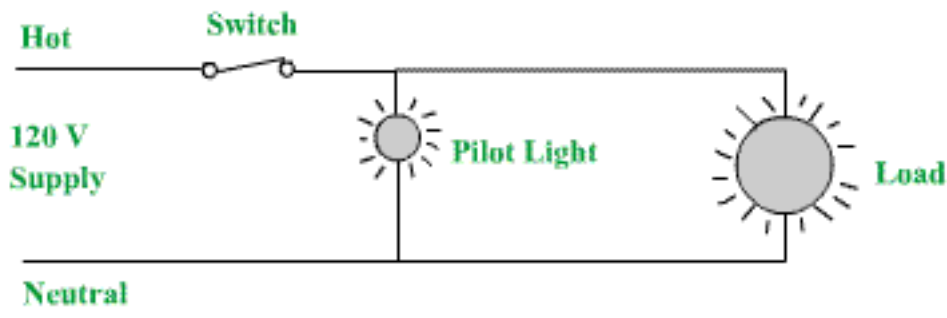


Figure 4.10. Connection of a switch with pilot light.

Dimmer switches. May be set to a desired level of illumination, and the intensity remains the same until changed at the dimmer. Their construction is based on electronic principles.

Timer switches. Are springs or electronically actuated devices that interrupt the circuit after some specified time. Timer switches are suitable for places where there is a tendency to leave the lights on when unoccupied.

Time clock. Is a clock with several elements to connect or disconnect a circuit as desired. Used frequently to automatically activate or deactivate motors, water heaters, etc.

Motion detectors. It is used to turn lights on or off if some motion is detected in certain covered area. Most of the motion detectors are equipped with a photoelectric device that does not permit their action during the day.

Relays. Employed in controlling a switching circuit using signals received through a coil or some electronic device. They are widely applied for remote control or when the control current should be much smaller than the controlled current, as in a motor starter, for example. During the last years their application in residential and commercial electrical system is being increased because of the use of computerized control systems for controlling lights and appliances in dwellings and buildings. Figure 4.11. shows an example of a lamp remotely controlled by radio from a distant location.

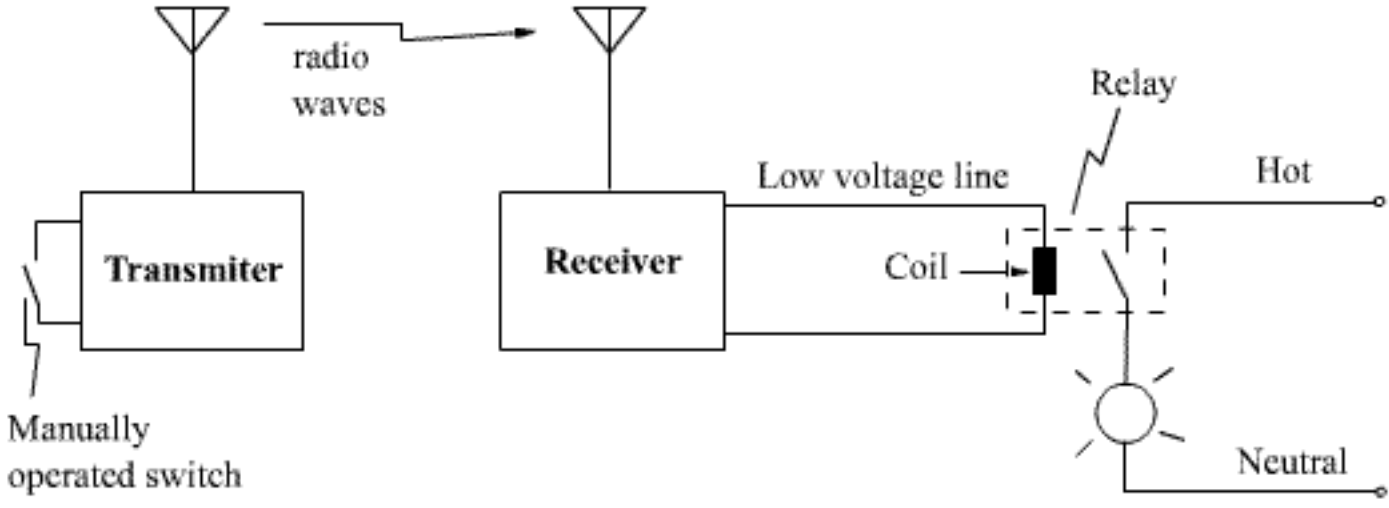


Figure 4.11. Remote control of a lamp

4.8. REVIEW QUESTIONS

4.1. The neutral wire is always black or red.

a) True

b) False

4.2. In a receptacle, the hot wire is connected to the brass-colored terminal.

a) True

b) False

4.3. The switch shall always interrupt the neutral wire.

a) True

b) False

4.4. Connect two three-way switches for controlling two lamps at the same time.