Knowledge Domain: Electrical
Unit: Switches
Skill: Replacing Switches

Tools and Parts Required:

1) **Various types of switches**
2) **A machine or circuit missing a switch**
3) **Soldering iron**
4) **Solder**
5) **Electrical tape**
6) **Wire stripper**
7) **Pliers**
8) **Spade connectors (optional)**

Introduction

There are switches in many types of medical equipment. Switches are located on both the user interface and inside the machine. This unit describes how to find an appropriate replacement switch for your machine.

Identification and Diagnosis

If you have a switch that is broken or missing, you will need to replace it.

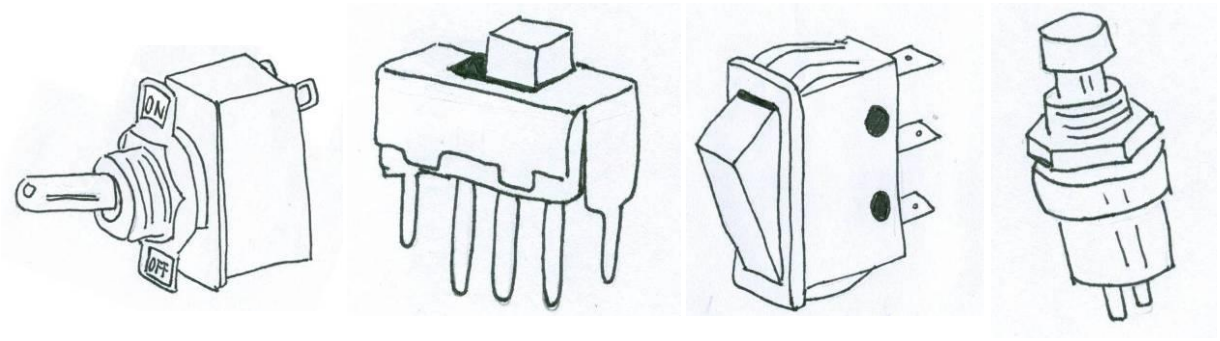
Here are some useful definitions for this unit:

- **Pole** - the number of switch contact sets
- **Throw** - the number of conducting positions or connections
- **Momentary Switches** - Switch returns to a default position (on or off) when released
- **Open** - off position, contacts not conducting electricity
- **Closed** - on position, contacts conducting

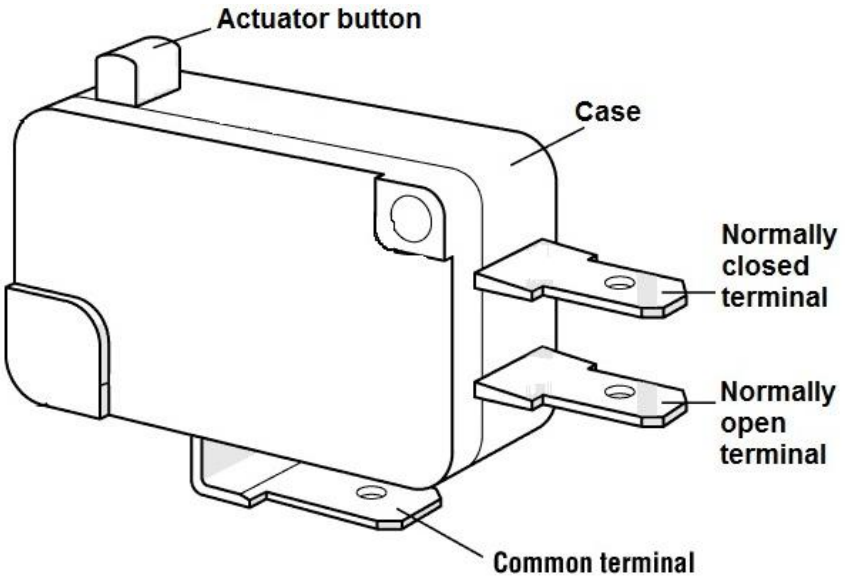
Types of Switches

1. Below are some examples of the common types of switches

Toggle **Slider** **Rocker** **Momentary**

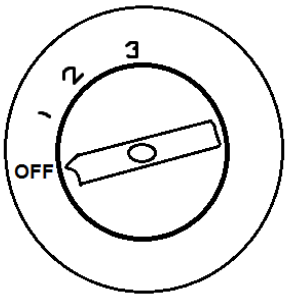


2. The micro-switch may commonly look as shown below.

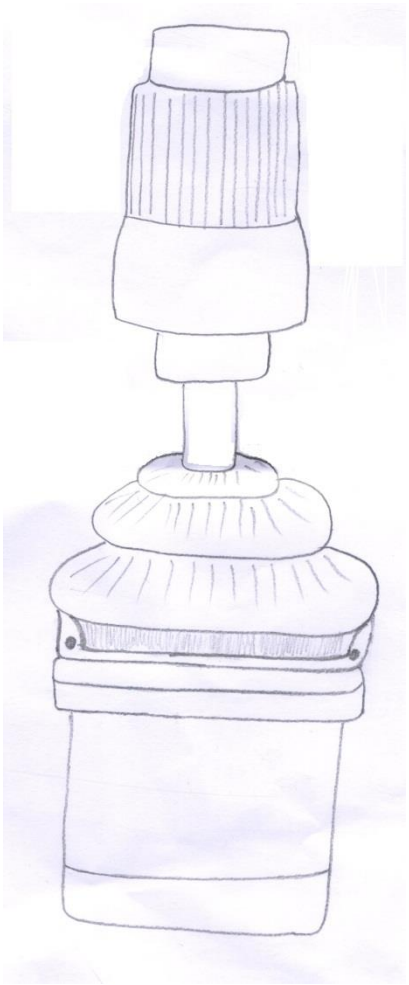


Micro-switches have low cost and high durability. A micro-switch may be either riveted or screwed. A faulty micro-switch can be replaced with an identical switch.

3. Selector switches may be used to change the intensity or amplitude of application in a device. Selector switches may be of Normally Open or Normally Closed configuration. A selector switch may appear as below.

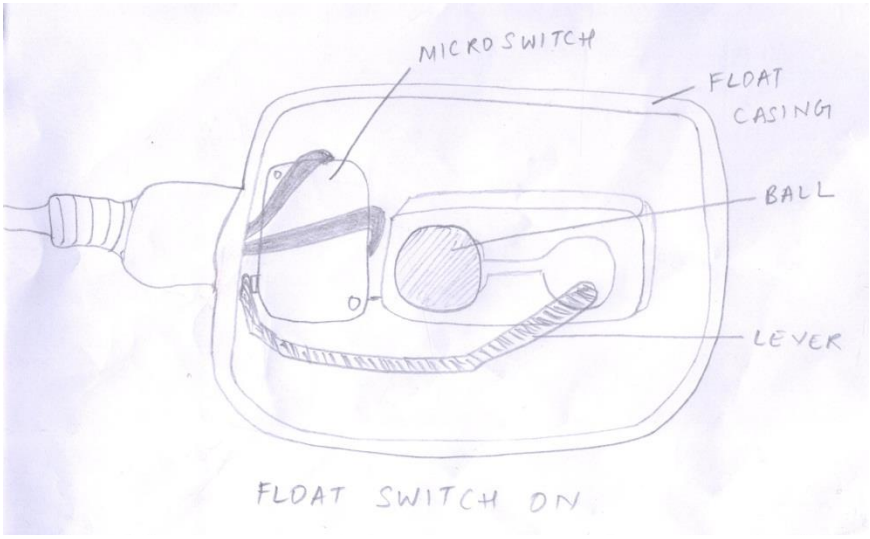


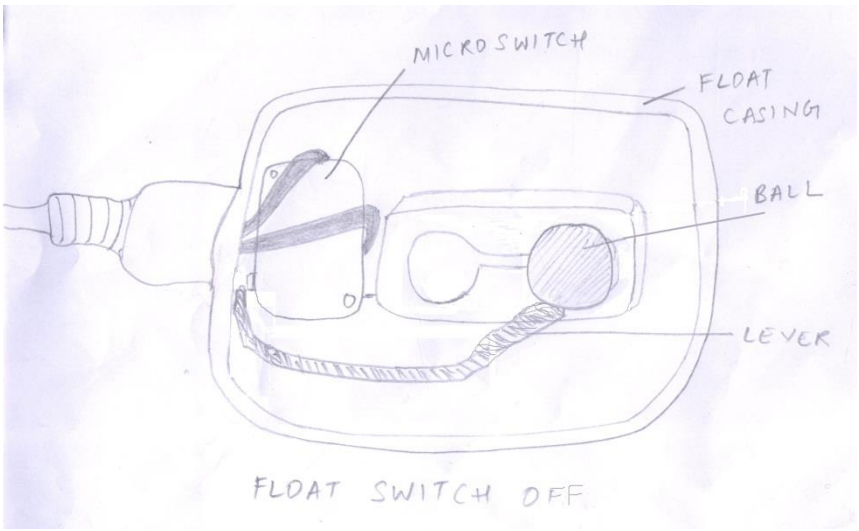
4. Joystick switches are seen in ultrasound scanners etc. Joystick switches are non-proportional switches. Such switches give ON/OFF signals for different mechanically possible combinations. An example of a joystick switch is given below.



5. Temperature switches: Please refer to the BTA skill *Electrical-HeatingElement-ReplacementThermostat.*

6. A liquid level switch is used to detect the level of liquid within a tank. Liquid level switches may be used in pumps, tanks, alarms etc. Liquid level switches may be small or large. A common type of liquid level switch is a float that raises a rod to actuate a micro-switch (image below). A float switch may have a faulty diaphragm. If the micro-switch is faulty, replace it with a new micro-switch.

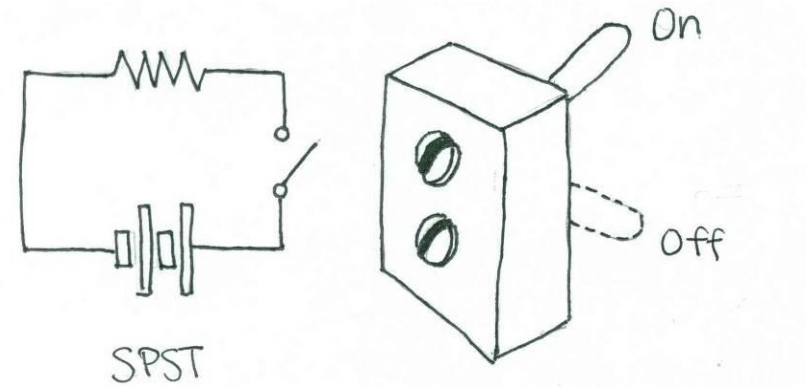
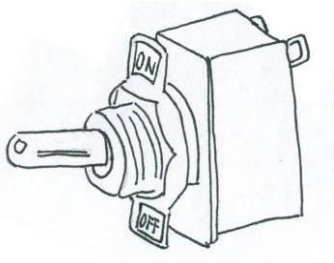
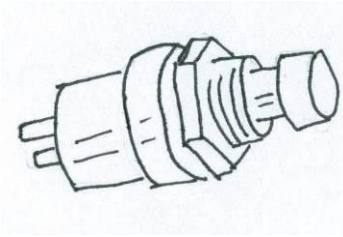
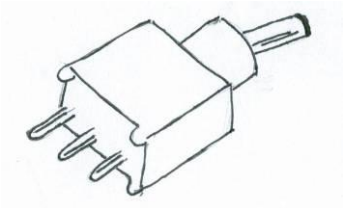


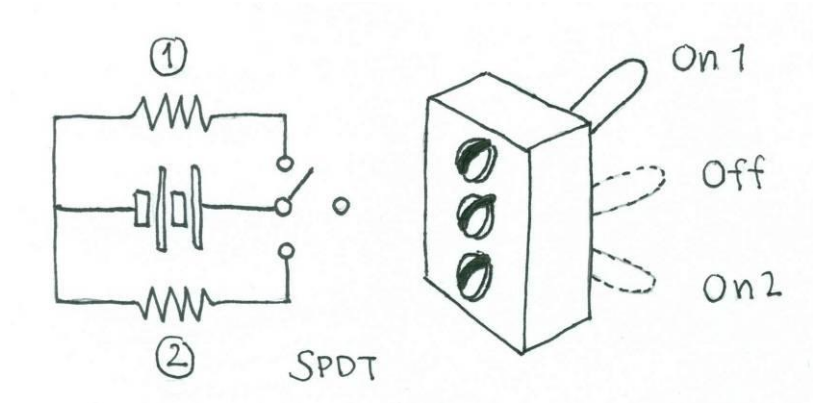


Procedure

1. Identify the method of operation of the switch.

2. Identify the number of poles and throws your switch needs. Use the number of contacts on the switch and their position to help you. Use the table to guide you.

Switch Type	**Example**
ON-OFF **Single Pole, Single Throw = SPST**  A simple on-off switch. A common example is a light switch. **Push-to-make switch (momentary SPST)** A push-to-make switch is normally off. The switch turns on when you press down. The switch returns to the off position when you release the button. A common example is a doorbell. **Push-to-break switch (momentary SPST)** A push-to-break switch is normally on. It turns off when you press down. The switch returns to the on position when you release the button.	 SPST toggle switch  SPST momentary switch
ON-ON **Single Pole, Double Throw = SPDT**	 SPDT toggle switch

<table>
<tr>
<td> 

This switch has two “on” positions. Each “on” position turns on a separate device. This type of switch is often called a changeover switch. For example, the switch can turn on a red light in one position and a green light in the other position.</td>
<td></td>
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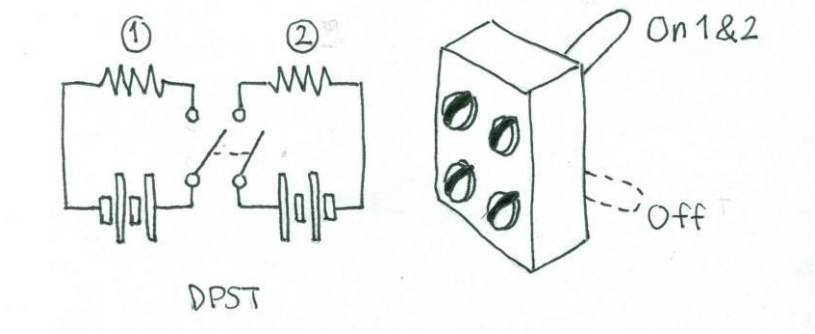
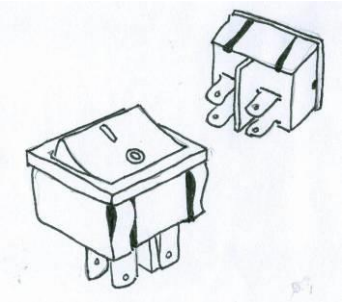
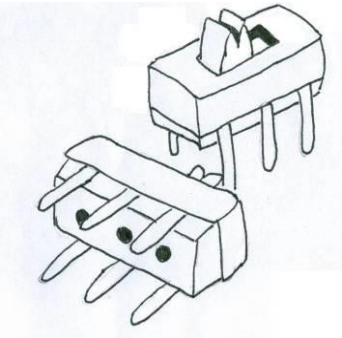
<tr>
<td>Dual ON-OFF
Double Pole, Single Throw = DPST
 

A pair of on-off switches operates together (shown by the dotted line in the circuit). A DPST switch is often used to switch mains electricity.</td>
<td> 
DPST rocker switch</td>
</tr>
<tr>
<td>Dual ON-ON
Double Pole, Double Throw = DPDT</td>
<td> 
DPDT Slider</td>
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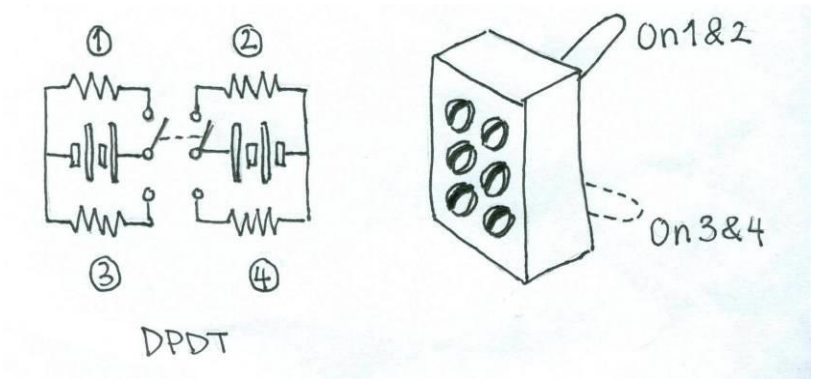
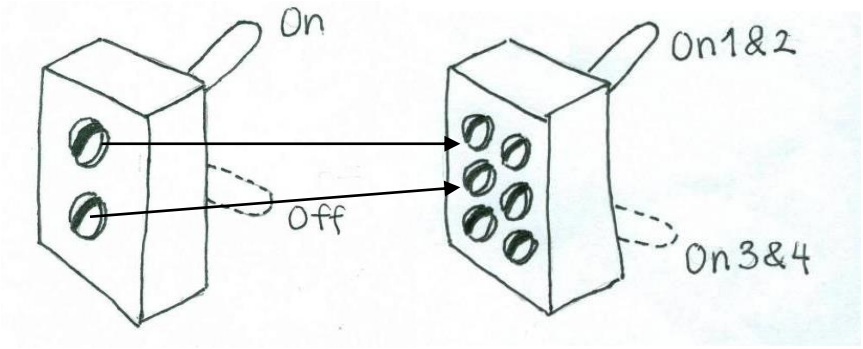
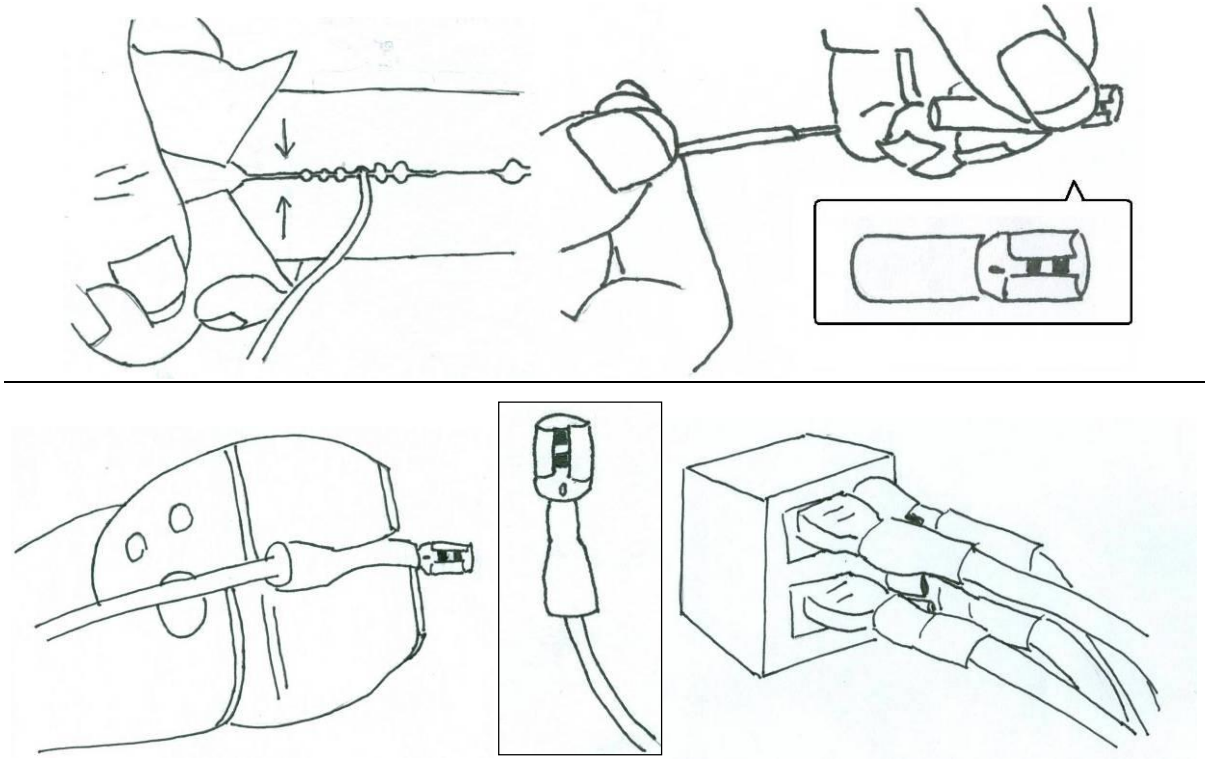
 A pair of on-on switches which operate together (shown by the dotted line in the circuit).	

3. Identify the rating of your switch. This rating should be marked on the original switch. The two parts to a switch rating are the maximum current and the maximum voltage. For example, a switch may be rated at 250 volts dc, 10 amperes.
4. Using the information from Steps 1-3, find an appropriate replacement switch.
    - The replacement switch should have the same or more number of throws as the original switch. (Double throw switches can always replace single throw switches. Single throw switches cannot replace double throw switches.)
    - The replacement switch should have the same or more number of poles as the original switch.
    - Always meet or exceed the voltage and current ratings. If you know the circuit is operating a voltage below the rating, you may be able to use a lower rating.
5. Unplug and turn off the machine. Never work on live wires.
6. Install the new switch by connecting the appropriate wires to the switch connectors. Make sure the switch closes the circuit(s) when in the “on” position. There may be multiple ways to wire the switch. Here’s one way to connect the wires to substitute a DPDT for a SPST:



7. Connect the wires with a soldering iron or wire crimps. Spade connectors are shown below:



First, strip the end of the wire. Next, put the stripped end of the wire into the plastic part of the spade connector. Use pliers to crimp the plastic part of the spade connector. Plug the spade into the back of the switch.

Exercise

Your instructor will give you a machine that requires a replacement switch. Identify which type of switch is needed and install the replacement switch.

Your instructor must verify your work before you continue.

Preventative Maintenance and Calibration

Always calibrate every medical device before returning it to use.