Series and Parallel Circuits

Key Terms: Series circuit, parallel circuit, current, voltage

Objectives: To study current flow in series and parallel circuits.

Equipment: Light board, power supply.

Discussion

This procedure is designed to give you practice in constructing series and parallel circuits, and to enhance your understanding how current flows in electrical circuits. The apparatus used is a combination of three light bulbs mounted on a board with various switches for connecting the bulbs in series combinations, parallel combinations, and series-parallel combinations. Figure 1 is a schematic diagram of the light board.

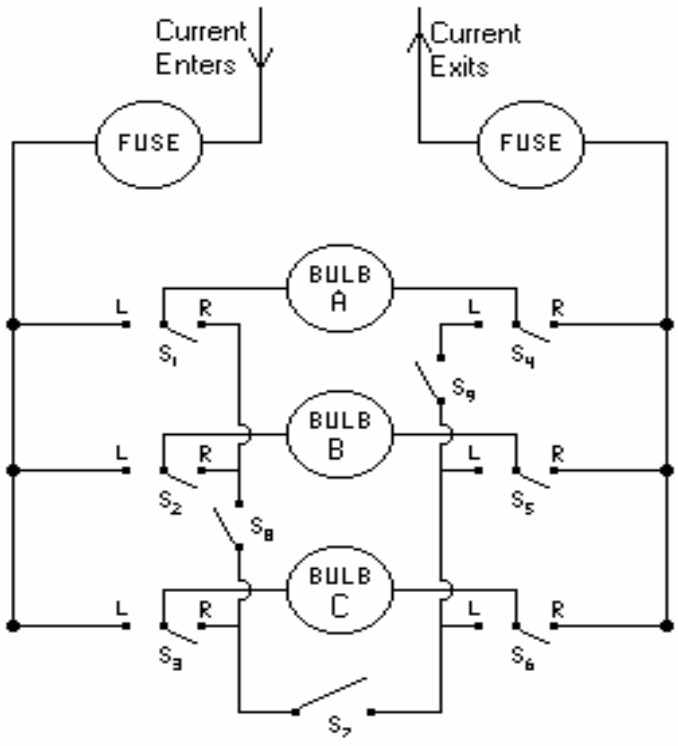

Figure 1. Diagram of Series and Parallel Circuit Board.

There are nine switches S_1, S_2, S_3, ..., S_9, on the board. Six of them (S_1 through S_6) are SPDT (single pole, double throw) switches which have three positions: open, closed to the right, or closed to the left. The other three switches (S_7, S_8, and S_9) are SPST (single pole, single throw) switches which have only two positions, open or closed.

Figure 2 shows the circuits that you are to construct by the proper positioning of the switches on the board. Note that the current must flow through the bulbs A, B, C in the indicated order. Even though the first 6 circuits are all series circuits, they will all have different switch settings. For each of these circuits, you should:

1. Use Ohm's Law ($V = IR$), and your knowledge of the behavior of resistors in series and parallel to predict the relative amount of current that will flow through each bulb when that circuit is energized. Assume that all of the bulbs have the same resistance. Recall:

Resistors in parallel: $\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}=\frac{1}{R_{eq}}$ Resistors in series: $R_1 + R_2 + R_3 = R_{eq}$

2. Predict the relative brightness each bulb will have, recognizing that the brightness of any bulb increases as the current increases.

3. Consider Figure 1 (or the circuit board itself) and trace out the path the current must follow to produce the desired effect.

4. Close the switches to the positions required to produce the current path you have traced and record the setting of each switch. If the setting of any switch (such as S7, S8, or S9) is irrelevant, list it as O/C (either open or closed).

5. Energize the board and observe the behavior of the bulbs to make sure that you have actually achieved the desired circuit.

6. Record the information below.

At any point during this exercise, you must be prepared to respond to questions from the instructor requiring you to:

- Trace out the path the current is following around the board.

- Explain why any given bulb has the relative brightness that is observed.

- Explain why it is necessary to have any one the 9 switches in the position that you have set it.

- Predict what would happen if the instructor should reposition any one of the 9 switches.

- Predict what would happen if the instructor should disconnect any one of the three bulbs.

Circuits to be Formed:

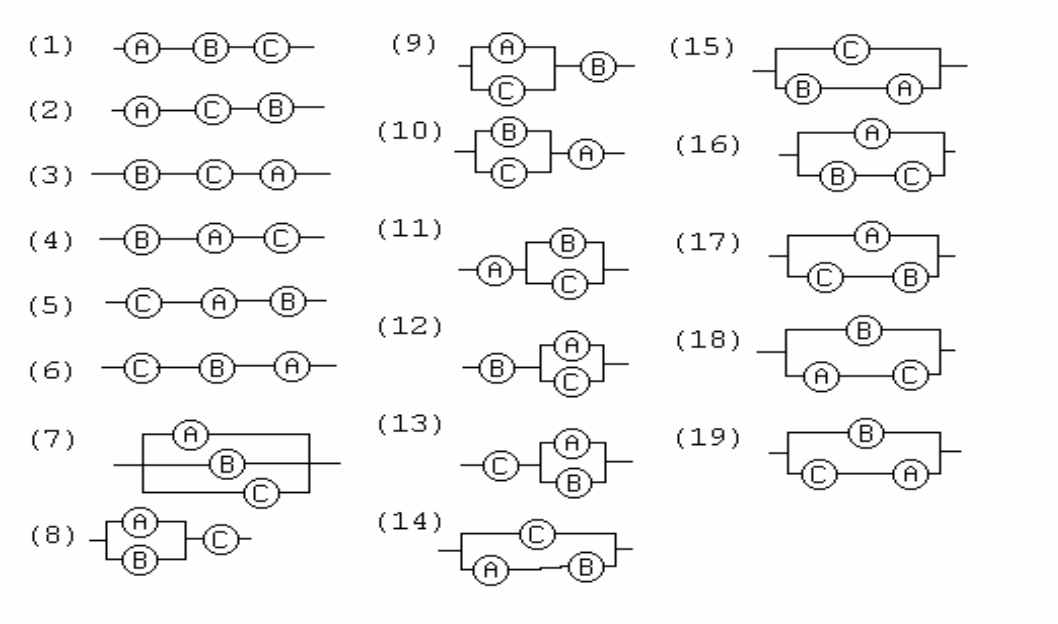

Figure 2.

Predictions

1.

2.

3.

4.

5.

6.

7.

8.

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10.

11.

12.

13.

14.

15.

16.

17.

18.

19.

	Switch Positions								
	S1	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**S9**
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
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17									
18									
19									

Questions for Thought

1. Explain the behavior of voltage and current across resistors in parallel branches of a circuit.

2. Explain the behavior of voltage and current across resistors in series.

3. Draw schematic diagrams of SPST and SPDT switches. How do these work?

4. Why are the light bulbs very dim for certain circuit arrangements?