

Using an electric motor fan engineering essay



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The resistance value for experiment 1. 1, 1. 2 and 1. 3 calculated and was 93. 23 , 101. 01 and 100. 90 respectively. The effect of voltage increase on temperature was recoded and how power is lost as heat was understood. How electrical current generate magnetic field was observed by using compasses and explained. An experiment was also carried out and explained in to how electromagnetic field is used to control electrical circuits involving more than one circuit in a relay. The change of electrical energy to mechanical was also investigated by using an electric motor-fan.

Background

Despite the famous experiment Benjamin Franklin, he did not invented electricity. Electricity exists naturally. It has always been around. A good example of electric flow that occurs naturally is lightening. Lightening is a flow of electrons between the ground and clouds. When clouds rub against each other or other objects they become charged. When the potential difference between the clouds and ground reaches a certain level a flow of electrons balances the charge, this exhibits a flash of light or lightening¹.

Electrical systems and components can be classified into several capabilities and used for many different applications. Electrical components and systems can be used to heat, power, sense, drive, detect, indicate, to transmit and receive data².

Electrical equipment such as light bulbs, batteries and electric generators are not needed for electric city to exist, although designed to use and harness electric city. If potential difference or voltage is maintained across a conductor an electric flow occurs, Figure1. The currents magnitude depends

on the voltage. The Ohm's law states that " the current through a conductor between the two points is directly proportional to the potential difference across the two points". Therefore if the potential difference applied across a conductor is changed the current will also change. If a device follows the Ohm's law the graph voltage vs current should have a straight line³.

By rearranging the equation 1, voltage can be calculated; in addition the resistance of material can simply calculated by dividing the voltage to the current see equation 1.

V

$$R = V/I$$

Figure1. An electric potential across a conductor³

Equation 13

The two types of circuits are series and parallel. Total resistance in series circuit can be determined by adding the individual resistors resistance. To find the resistance of two or more resistors connected in parallel, the sum of the inverse individual resistance is used², Equation2.

Equation 24

In electrical circuit some power is lost as heat. Resistance and heat loss is directly proportional for a given volts. Therefore if the volt is increased the resistance will increase, this will then result in a great deal of heat being lost³.

When there is a need to control more than one circuit, a relay is used. Relay is a switch operated by electric. The mechanical movement of a relay is often controlled by magnetic force. The flow of current through the relay coil generates a magnetic field and changes the switch by attracting a lever. Relay aid one circuit to switch to another circuit and operate completely separate from the initial circuit5.

Relay coil

NO

COM

NC

Figure 2. Relay contact5

Key

COM = Common, always connect to this, it is the moving part of the switch.

NC = Normally Closed, COM is connected to this when the relay coil is off

NO = Normally Open, COM is connected to this when the relay coil is on

If an electrical current flows through a wire, a magnetic field is created due to the moving charges. Figure 3 demonstrates the magnetic fields in a straight conductor. The magnetic field for a straight conductor circles around the conductor. As illustrated from figure 4, a wire is coiled up to make a solenoid. The flow of the current determines the magnetic field direction. Each loop experiences its own magnetic field and the total magnetic field is the sum of individual loop. In addition the magnitude of the total magnetic

field of a solenoid is directly proportional to the number of coils a coiled wire has⁷.

Magnetic Field Around a Wire VRML Model

Figure 3. Magnetic fields in Straight conductor⁷

Magnetic Field of a Solenoid VRML Model

Figure 4. Magnetic fields in solenoid⁷

Electric motor is one of the very useful appliances use electric power to turn in to mechanical energy. To understand how an electric motor work simply imagine a nail wrapped with a wire and connected to a battery Figure 5. If the battery is connected to the wire, the nail would eventually become a magnet and have a south and North Pole.

If the nail is suspended in the middle of a horseshoe magnet as in figure 5, the north end of the nail would be repelled away from the horseshoe's north end and attract to the south end of the horseshoe. By doing this the nail would half turn and stop at the original place. To maintain a full turn the electromagnetic field of the nail should be flipped at a very precise moment. This is done simply by changing the direction of the electrons flow⁶.

<http://static.ddmcdn.com/gif/motor-nail-in-horseshoe.gif>

Figure 5. Electro magnet in a horseshoe magnet⁶

Experimental

Experiment 1. 1: Electrical circuit

As illustrated in figure 6, a series circuit was set up and one resistor was used across the circuit. Multi-meters were used to record the voltage across the resistor and current. Five different voltages in the range of 2 to 12 volts were applied and the current was recorded for each for each volts.

Power

R1

V

A

Figure 6. Series one resistor circuit2

Experiment 1. 2

Similar procedure was used to record the voltage and current for the second experiment, this time though two resistors were used.

V

Power

R1

R2

A

Figure 7. Series two resistor circuit2

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Experiment 1.3

In the third experiment two resistors was set up in a parallel circuit. Similar method to experiment one and two was used to record the voltage and current.

Power

A

R1

R2

V

Figure 8. Two resistors in parallel2

Experiment 2: Temperature vs. voltage

In the fourth experiment investigates the relationship between voltage and temperature across a resistor. Similar circuit to experiment was, but this time one of the multi-meter was used set to record temperature. A thermocouple as shown in figure 9 was used to detect the temperature change and this was fed to the multi-meter8.

<http://images.picotech.com/se001-thermocouple.jpg>

Figure 9. Thermocouple8

Experiment 3: Relay

Figure 10 shows the mechanism of the relay. A switch was used to control the relay by switching between the two circuits.

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Figure 10. Diagram for connection of experiment with relay and LEDs2

Experiment 4: Electric motor – Fan

An electric motor was used and given a power of 12 volt. Electric current was controlled by a switch and the fan rotated as due to the magnetic field generated by the electric.

Experiment 5: Magnetism

In these experiment two methods was used to test electro magnetism of electric of the flow of current.

A wire used to flow electricity and magnetic compass was placed around the wire.

In the second method a coiled wire was used and compasses was placed in the inside and outside of the coiled.

Results

Table 1. Experiment one and two

Single resistor circuit

Two resistor in series

Two resistors in parallel

V

Amps

Temperature C0

V

Amps

V

Amps

2

0. 0198

24

2

0. 0099

2

0. 0396

4

0. 0390

25

4

0. 0198

4

0. 0793

6

0. 0990

26

6

0. 0297

6

0. 1189

8

0. 0792

28

8

0. 0396

8

0. 1587

10

0. 0990

30

10

0. 0495

10

0. 1981

Note: The value of current highlighted for single resistor at 6 volts is an anomaly.

Figure 11. Current vs Voltage

Table 2. Resistance calculation

Total resistance/ Ω

Power in v

Series circuit

Parallel Circuit with 2 resistors

1 resistors

2 Resistors

2

101. 01

202. 02

50. 50

4

102. 56

202. 02

50. 44

6

60. 60

202. 02

50. 46

8

101. 01

202. 02

50. 40

10

101. 01

202. 02

50. 47

Average

93. 23

202. 02

50. 45

Below is resistance calculation narrated;

One resistor series circuit =

Two resistors Series circuit =

Two resistors Parallel Circuit

Using equation 2, $R = (Assuming R1 = R2)$

$50. 45 = R1 R1 + R2 = 100. 90 \Omega$

Experiment 2: Temperature vs. voltage

The graph shows a positive correlation between voltage and temperature increase.

Figure 12. Voltage vs Temperature

Experiment 3: Relay

When the switch was turned on LED one turned on and when the switch turned off LED one light gone out and LED two turned on.

Experiment 4: Electric motor – Fan

The electric motor-fan started to spin only when the electric current started to flow. This was controlled by a switch for convenience.

Experiment 5: Magnetism

The results of electro magnetism were observed in experiment 5. When a single wire was used the compass needles aligned themselves towards the direction of the current flow. In the coiled wire when the compass was placed inside the coiled wire the compass pointed towards the direction of the electric flow. When the compasses was placed outside the solenoid the compasses experiences a great deal of deflection in comparison with the single wired cable.

Discussion

Experiment 1. 1 – 1. 3 circuit

Figure 11 demonstrates an increase in voltage resulted on an increase in current. For the circuits with two resistors in parallel and series the graph was showing a positive correlation between the voltage increase and current increase. For the series circuit with one resistor there was an anomaly when the voltage was set to 6 volts. The increase in current at 6 volts was too high, and this resulted on the graph being nonlinear. To make assumptions that the circuit obeys Ohmic law the graph should be linear. Possible source of errors;

Human error (error when recording figures)

Faulty multi-meter being used

Faulty resistors or Faulty power supply reading

Experiment 2: Temperature vs voltage

As illustrated in figure 12, as the voltage increase the temperature across the resistor also increased. The temperature was directly proportional to the voltage increase. Temperature increase was steady for every additional volts applied for up to 6 volts. Temperature increase was doubled then doubled when 8 volts was applied. Some of the factors that can affect the amount of heat loss in a circuit are;

Type of material used for wiring or resistor (some material are good conductors and some are very good insulator)

Wire diameter (the smaller the diameter the harder for the electrons to move through)

Length of wiring

Temperature of the material/conductor (lower temperature result in lower resistance and indeed lower heat loss)³

The sharp increase in temperature was due to possible errors;

Faulty thermocouple

Leaving a particular voltage slightly longer than the another

Breathing near the thermocouple (increase in the overall temperature)

Experiment 3 Relay

Figure 10 demonstrates the relay experiment. Since the relay mechanism was very small to be observed by the naked eyes LED was used to indicate if

the electrical flow was switching in between the two circuits every time the switch was hit. TQ team⁷ States that the total magnetic field in a loop is the sum of its individual loop. Since moving charged particles generate electromagnetic field many charged particles generate a higher magnetic field. Therefore higher resistance in the wire coiling of a relay could cause the relay not being able to attracting a lever. Higher resistance in relays could be caused by rusting or using materials with low conductivity.

Experiment 4 Electric motor-fan

The power used in the Electric motor-fan was DC current. The current in DC always goes through one direction. The electric-fan began rotating when the current starts to flow. The current flow was switched over, as the polarity of the volt switched over, it was expected the motor start running the opposite direction instead the motor was stopped. The fan was possibly fitted with a device that only allows a one direction flow of current⁹. A diode was one of the possibilities that the electric motor-fan was fitted by. A diode is a two terminal device, with features of some systematic transfer of electric city character. A diode have a zero resistance to electric flow in one direction and high resistance (100%) resistance in the other direction, therefore electrical current flow only in one direction.

Experiment 5 Magnetism

As demonstrated from figure 3 and 4 electric current produces magnetic field. The compass used for the single wire deflected and seen aligning itself with the direction of the electric current. By observing the deflection of the compass needle, the North and South Pole of the magnetic field was deducted¹⁰.

Conclusion

The goal of the experiment was to understand the role of electricity in modern technology. Resistance in series and parallel circuits were tried, electromagnetism and its applications explained. The experiments deduction narrated below;

With the exception of one anomaly result the circuits in experiment one obeys Ohmic law, therefore a linear graphs.

In series circuit the resistance value doubled when another resistor was added. As it can be observed from table 2 resistance values for the parallel with two resistors was almost half the value for the series circuit with one resistor. Parallel circuit resistance was very small when compared with the resistance value in the series circuit with the same number of resistors. The value for the resistors calculated as 93. 23 , 101. 01 and 100. 90 respectively.

In experiment two, power dissipation promotes temperature increase .

Relay experiment demonstrates the control of more than one circuit by using magnetic field of electric current.

Charged moving particles produce a magnetic field

Electric motor-fan converts electrical power in to mechanical by the help on a magnet inside the motor.

Compasses used to observe the direction of an electric current. The greater the loop the greater the deflection the compass experience. Figure 3 and 4 demonstrates the magnetic field in a single wire and solenoid.