Turbines, Generators and Power Plants

ESP
It's Science Time!

Sasha, Maria and Darrell were at Sasha's house to work on a science and engineering project. As they entered Sasha's room, Maria turned on the light switch. Pop. The light bulb burned out in a flash of light.

"Hey guys, did you see that? " asked Maria. "I hate when that happens. It always startles me."

"Me too," said Darrell. "Someone should invent a permanent light bulb that would never have to be changed."

"That would be a great invention!" said Maria. "What are you doing this weekend?"

"Very funny," said Sasha. "My mom will be home soon. I will ask her to change the bulb. Let's work in the kitchen where there is plenty of light."

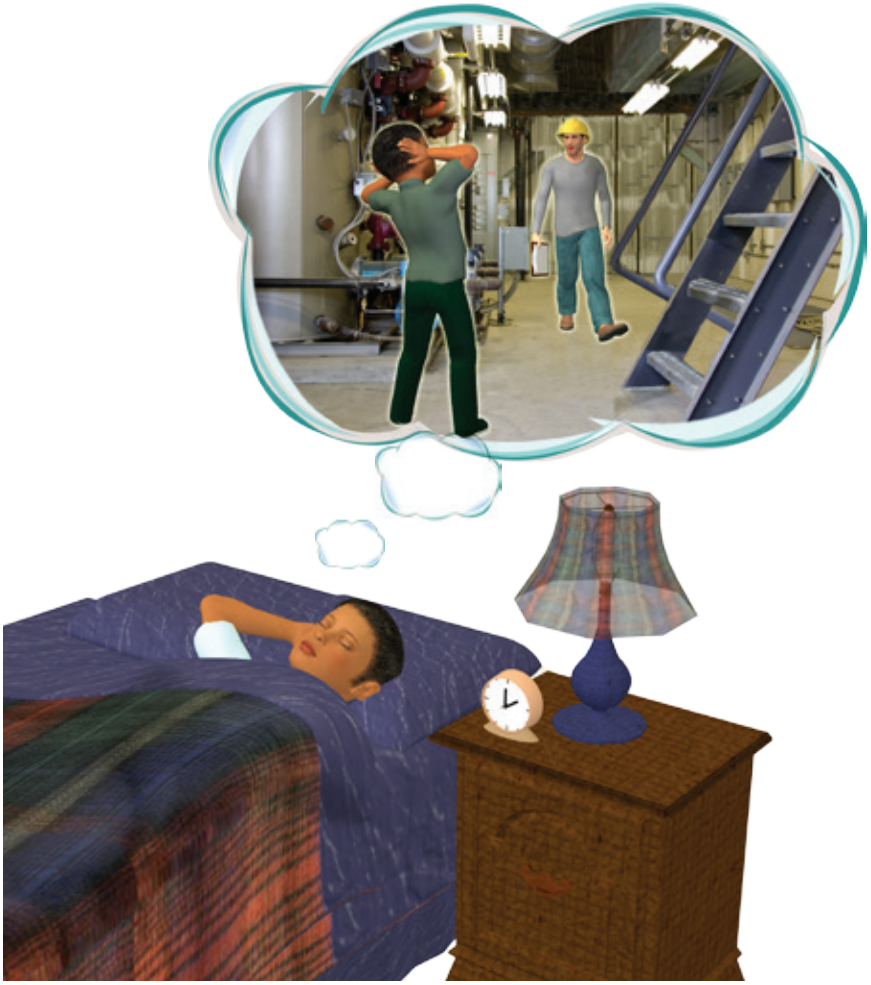
"Sasha, have you ever thought about the source of electricity," asked Darrell. "I know it comes into our houses through the power lines outside. But where does it originate?"

"I don't know, Darrell. Ask Mr. Thomas in science class tomorrow," said Sasha.

"That's a good idea. I will ask him," said Darrell.

Later that night, Darrell was in his room getting ready for bed. He was remembering about the burned out light bulb just as he was falling asleep…….

He suddenly found himself inside a huge factory. The noise was deafening. He had to cover his ears. He could barely hear the man with the hard hat yelling something in his direction.



"Young man, what are you doing here?" said the man with the hard hat.

"Who are you? Where am I?" asked Darrell.

"You're inside the Springville Power Plant, and we are one of the largest producers of electricity in the country. My name is Mr. Charge, and I'm the plant supervisor," said the man with the hard hat.

"That explains it! My friends and I were discussing electricity this afternoon. I must be having a dream. My name is Darrell. It's nice to meet you," said Darrell.

"Welcome, Darrell, I can show you around, but you will have to be careful. Put on this hard hat and follow me," said Mr. Charge.

Darrell followed the man into an extremely large room filled with strange looking machines connected by pipes.

"Darrell, do you see those enormous containers over there? They are called the boilers, and they are filled with water that is heated until it turns to steam. The big pipes carry the steam into the next room where the turbines are located," said Mr. Charge. "Here at the Springville Power Plant, we burn coal to heat the water in the boilers. Other power plants burn wood, oil, or natural gas."

"It must take a great deal of heat to boil a pot of water that huge!" said Darrell. "You said the steam goes through those pipes and into the turbines in the next room. What exactly are turbines?" asked Darrell.

"Let's go take a look," said Mr. Charge. "Follow me, and stay close."


Boilers

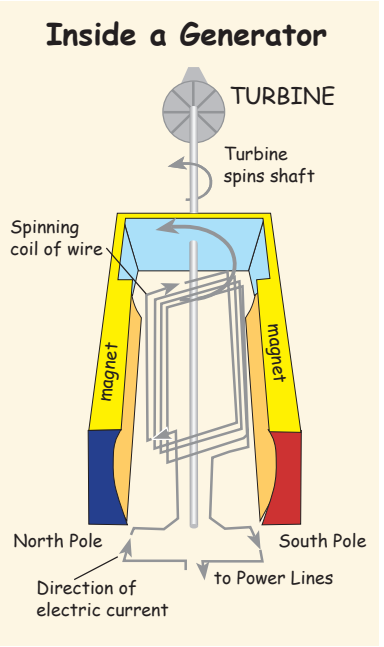
Darrell followed Mr. Charge into the next room. He saw the big pipes extending from the boilers. They were connected to another enormous machine.


Turbine

"This is the turbine. The big pipe on the side is where the steam comes in. The steam is hot. It is under tremendous pressure. When the steam moves into the turbine, it makes the turbine spin. The turbine is like a huge fan with hundreds of blades. The steam causes the fan blades to spin rapidly," said Mr. Charge. "A long shaft is connected to the turbine. When the turbine spins, the shaft spins too. The shaft powers another machine called a generator."

"Wow!" said Darrell. "How does the generator work?"

"The generator is like a big box lined with powerful magnets. The steam from the boilers spins the shaft attached to the huge fan inside the turbine. On the other end of the shaft is a large coil of wires. The coil spins inside the magnetic field created by the magnets. This generates a current of electricity in the wire. So, what the generator actually does is transform mechanical energy from the spinning shaft into electrical energy," said Mr. Charge. "A British scientist, Michael Faraday, developed this process in 1831. Faraday discovered that an electric current will flow through a wire that is moved through a magnetic field. The mechanical energy of the moving wire is changed into electrical energy."




Electrical Generator

"Now I understand. The electricity created by the generator is the power we use in our homes, schools and businesses," said Darrell. "Where does the electricity travel after it leaves the power plant?"

"I will show you," said Mr. Charge. "Remember to stay close. We are going outside now."

"The electricity produced at the power plant has to get to the customers through power lines. Our whole country is criss-crossed with power lines. Electricity moves along the power lines to get to its destination," explained Mr. Charge.

"Is the electricity coming from the power plant powerful enough to travel long distances?" asked Darrell. "Does it lose some of its strength the farther it goes? Not everyone lives near a power plant."

"That's an excellent question, Darrell!" exclaimed Mr. Charge. "You are correct. The electricity indeed loses some of its power as it travels. So the first stop after the generator is the transformer."

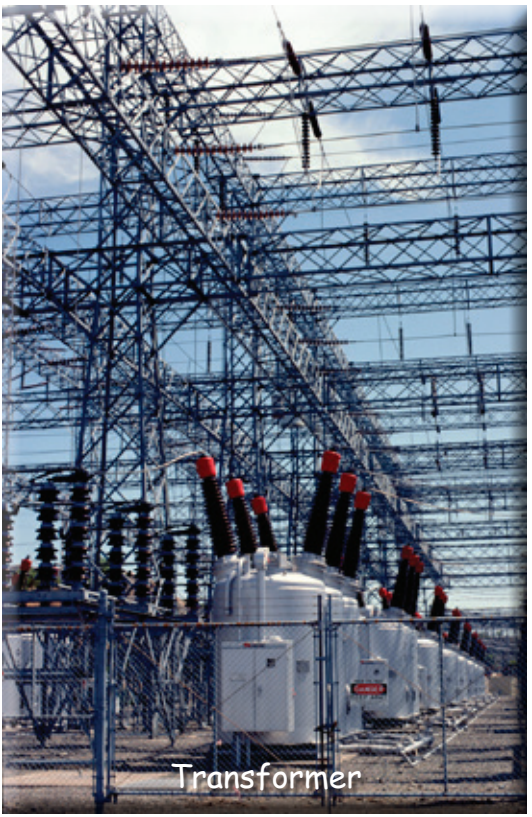
"I recognize that word!" said Darrell. "Transform means to change something. What does the transformer change?"

"Stay close, Darrell. Let's go take a look," Mr. Charge said.

"Actually, Darrell, there are two different kinds of transformers," said Mr. Charge. One is called a step up transformer, and the other is called a step down transformer. The electricity that leaves the power plant needs to be stepped up to travel a tremendous distance. The transformer increases the voltage of electricity. Voltage is how much "push" the electricity is going to have."

"That makes a lot of sense," said Darrell. "But what about the step down? Where does that happen?"

"High voltage wires conduct the electricity from the transformer at the power plant to substations. You may have seen a substation at the outskirts of town. These substations are closer to our homes and businesses," said Mr. Charge. "At these substations, the electricity is stepped down to a lower voltage."



Transformer

"And from there it comes directly into our homes?" asked Darrell.

"Not yet. It is still too powerful. Big factories and electric subway systems can use electricity directly from the substation, but it must be stepped down one more time before it can be used in residential neighborhoods," said Mr. Charge.

"Where does that happen?" asked Darrell. "Is there another substation?"

"Sort of, let's go look," said Mr. Charge. "Here is a small transformer right in your neighborhood up there on the utility pole. This transformer reduces or steps down the voltage of the electricity one last time before it comes into your home."

"I have been in some neighborhoods where I have not seen any power lines or utility poles," said Darrell. "How do they get their electricity?"

"The same way!" exclaimed Mr. Charge. "In some neighborhoods, the power lines are located underground where they are protected from the weather. Severe weather can cause the lines to sag or break. Have you ever seen what can happen to power lines in an ice storm?"

"I sure have!" said Darrell. "I remember we lost power in my house for a whole week after an ice storm."

"Well, Darrell, here you are, home again. Look over there. That is your house. We have followed the path of the electricity all the way from the power plant to your street," said Mr. Charge. "I only have one more thing to share with you. When the electricity enters your home, it passes through a meter. The meter measures how much electricity your family consumes and informs the power company. The power company then knows how much to charge your family for the electricity they use. It then

goes through a fuse box or circuit breaker in the house. Then it moves to the lights and appliances."

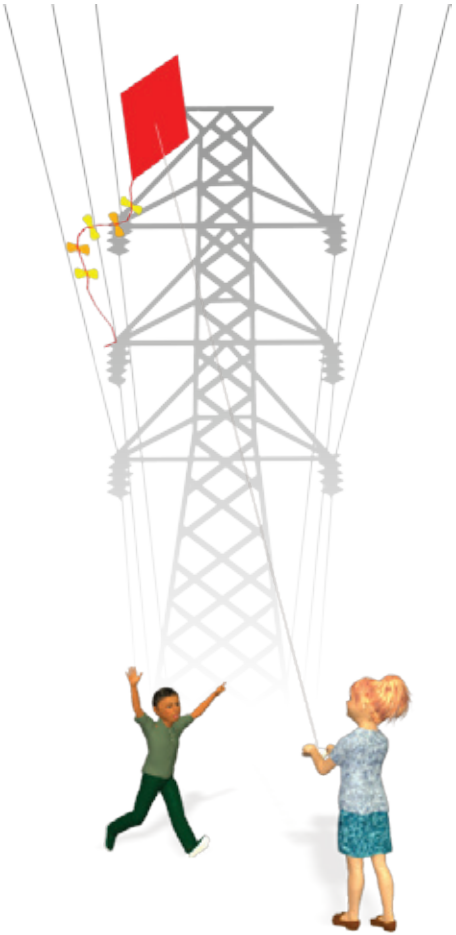
"This has been a fantastic dream, Mr. Charge. I cannot wait for morning so I can tell Sasha and Maria about my experience. I'll tell them all about what I have learned," said Darrell. "Thanks a lot!"

Just then, a strange buzzing sound began. Darrell turned over and shut off the alarm clock. He looked around and saw he was back in his bedroom again.

"Sasha and Maria are never going to believe this one!" Darrell chuckled to himself as he got ready to head off to school.

Safety Notes about Electricity

- Never play around a transformer or substation. The electricity from a transformer is very powerful. Tell your parents to call the electric company if a toy lands in or around a transformer.
- Do not release helium balloons, especially Mylar balloons, into the air. The balloons can get caught in power lines. This can cause problems, including fires.
- Do not fly a kite near power lines. The kite string could link across the wires and complete a circuit. The electricity could then be passed on to you holding the string.
- You should never touch wires inside or outside your house. An electrician or the power company knows the proper way to fix high voltage electrical problems.



Electrical Circuits
Turbines, Generators and Power Plants

Correlation

Fountas & Pinnell	U	
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