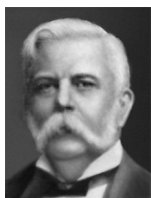




## 16.4 George Westinghouse

*George Westinghouse was both an imaginative tinkerer and a bold entrepreneur. His inventions had a profound effect on nineteenth-century transportation and industrial development in the United States. His air brakes and signaling systems made railway systems safer at higher speeds, so that railroads became a practical method of transporting goods across the country. He promoted alternating current as the best means of providing electric power to businesses and homes, and his method became the worldwide standard. Westinghouse obtained 361 patents over the course of his life.*

### A boyhood among machines



George Westinghouse was born October 6, 1846, in Central Bridge, New York. When he was 10, his family moved to Schenectady, where his father opened a shop that manufactured agricultural machinery.

George spent a great deal of time working and tinkering there.

After serving in both the Union Army and Navy in the Civil War, Westinghouse attended college for three months. He dropped out after receiving his first patent in 1865, for a rotary steam engine he had invented in his father's shop.

### An inventive train of thought

In 1866, Westinghouse was aboard a train that had to come to a sudden halt to avoid colliding with a wrecked train. To stop the train, brakemen manually applied brakes to each individual car based on a signal from the engineer.

Westinghouse believed there could be a safer way to stop these heavy trains. In April 1869, he patented an air brake that enabled the engineer to stop all the cars in tandem. That July he founded the Westinghouse Air Brake Company, and soon his brakes were used by most of the world's railways.

The new braking system made it possible for trains to travel safely at much higher speeds. Westinghouse next turned his attention to improving railway signaling and switching systems. Combining his own inventions with others, he created the Union Switch and Signal Company.

### Long-distance electricity

Next, Westinghouse became interested in transmitting electricity over long distances. He saw the potential benefits of providing electric power to individual

homes and businesses, and in 1884 formed the Westinghouse Electric Company. Westinghouse learned that Nikola Tesla had developed *alternating current* and he persuaded Tesla to join the company.

Initially, Westinghouse met with resistance from Thomas Edison and others who argued that *direct current* was a safer alternative. But direct current could not be transmitted over distances longer than three miles. Westinghouse demonstrated the potential of alternating current by lighting the streets of Pittsburgh, Pennsylvania, and, in 1893, the entire Chicago World's Fair. Afterward, alternating current became the standard means of transmitting electricity.

### From waterfalls to elevated railway

Also in 1893, Westinghouse began yet another new project: the construction of three hydroelectric generators to harness the power of Niagara Falls on the New York-Canada border. By November 1895, electricity generated there was being used to power industries in Buffalo, some 20 miles away.

Another Westinghouse interest was alternating current locomotives. He introduced this new technology first in 1905 with the Manhattan Elevated Railway in New York City, and later with the city's subway system.

### An always inquiring mind

The financial panic of 1907 caused Westinghouse to lose control of his companies. He spent much of his last years in public service. Westinghouse died in 1914 and left a legacy of 361 patents in his name—the final one received four years after his death.



## Reading reflection

1. Where did George Westinghouse first develop his talent for inventing things?
2. How did Westinghouse make it possible for trains to travel more safely at higher speeds?
3. Why did Westinghouse promote alternating current over direct current for delivering electricity to businesses and homes?
4. How did Westinghouse turn public opinion in favor of alternating current?
5. Together with a partner, explain the difference between direct and alternating current. Write your explanation as a short paragraph and include a diagram.
6. How did Westinghouse provide electrical power to the city of Buffalo, New York?
7. Ordinary trains in Westinghouse's time were coal-powered steam engines. How were Westinghouse's Manhattan elevated trains different?
8. **Research:** Westinghouse had a total of 361 patents to his name. Use a library or the Internet to find out about three inventions not mentioned in this brief biography, and describe each one.