



## **Cincinnati History Museum**

### **Gallery Guide for *Forming A New World:***

### ***Cincinnati's Machine Tool Industry, 1850-1930***

At the turn of the 20th century, Cincinnati was widely regarded as the machine tool capital of the world. In this exhibit, a working machine shop shows how power was generated and transmitted to three typical machines used in shops at the eve of the 20<sup>th</sup> century. Volunteers in the shop use the machines to demonstrate the different metalworking processes the machines perform. Other displays focus on historically significant machine tools and the entrepreneurs who built Cincinnati's machine tool industry. Posters and photographs show what conditions were like in Cincinnati's machine shops while common objects containing parts made with machine tools illustrate the impact of the machine tool industry on everyday life.

#### **Themes**

- For nearly 100 years, Cincinnati was widely regarded as the machine tool capital of the world.
- Machine tools are used to precision-make interchangeable metal parts for a variety of products.
- Machine tools helped spur the Industrial Revolution by making mass production of many types of goods possible.
- Machine tools contributed to the evolution of modern society by making consumer goods affordable and widely available.

#### **Background**

Between 1850 and 1900, Cincinnati became the machine tool capital of the world. More than 15,000 people worked in over 40 machine tool firms at the industry's peak, making parts for products such as sewing machines, bicycles, automobiles and typewriters to name just a few. Huge companies like Cincinnati Milling Machine employed hundreds of people while smaller shops had only a few dozen employees. By the beginning of World War I, Cincinnati-built machine tools accounted for about 13 percent of all machine tools produced around the world and had earned an international reputation for excellence.

Machine tools are tools that are used to form, cut, grind and scrape pieces of metal into parts for machines. The development of precision machine tools meant that for the first time manufacturers could produce truly identical machine parts that could be used interchangeably. The armaments industry was the first to produce objects made of interchangeable parts because the military needed vast numbers of weapons that could easily be fixed far from any machine shop. Mass production of objects made from interchangeable parts became known as the "American system" and spread to other industries manufacturing everything from clocks to locomotive engines.

The working machine shop in the exhibit includes a vertical steam engine and three machine tools that are typical of machines found in shops at the turn of the 20<sup>th</sup> century. The steam

engine powers the machine tools by using a system of belts that drive a main lineshaft and individual jackshafts for each machine. The machines are: a milling machine, a lathe and a shaper.

The milling machine was the most important machine in a 19<sup>th</sup> century machine shop. The most versatile of all machine tools, a milling machine uses a fast-spinning multiple-toothed cutter to remove metal from the piece being worked on. It has three possible movements—longitudinal, vertical and horizontal—that allow it to cut irregular shapes with extreme accuracy and eliminate the need for a great amount of hand filing.

The lathe shapes and finishes round pieces such as pistons, wheels and cylinders. The metal piece being worked spins around while a sharp steel cutter is applied to the edge to produce a finished piece. A cutter on the inside of the piece produces a finished interior cavity.

On the shaper, the cutting edge slides against a stationary workpiece and cuts on one stroke, then returns to its starting point and cuts again on the next stroke after a slight lateral displacement. The shaper can handle work that cannot be done on the other machines and is flexible enough to be used in small shops and small-lot production plants.

A fourth machine tool, a planer, is on display across from the shop. It has the same function as a lathe but shapes and finishes flat pieces instead of round ones. On the planer, a flat piece of metal is secured on the bed of the machine, where a blade removes thin shavings of metal until the piece is completely smooth. Before machine planers became available in the 1830s, the finishing work was done by skilled workers using hand tools—a very laborious and time-consuming process.

A skilled machinist is a key element in the operation of a machine tool. He chooses the tool and settings for the job and decides how fast the machine will go. He watches the machine as it operates and then measures the finished product to ensure its precision. Machinists worked 10 hours a day, six days a week, in noisy, dirty shops. They had no paid vacations, holidays, sick leave or workmen's compensation and, until World War II, little protective clothing. It took years of training to become a skilled machinist. Training began at about age 10 as an apprentice doing unskilled work and running errands. Apprenticeship was followed by more years of training as a journeyman; when that training was completed, the journeyman qualified as a master craftsman. Despite the long hours and poor conditions, skilled machinists took pride in their tools and skills.

Five men and the companies they founded were especially recognized as innovators and leaders in machine tool quality and design. John Steptoe (1805-1888), a native of England who immigrated to Cincinnati in the 1840s, was probably the first in the Queen City to manufacture machine tools. About 1850, he began producing a wood planer that was used extensively in local woodworking shops. Marketing his product proved so profitable that in 1855, Steptoe went into partnership with Thomas McFarlan, a carpenter who believed that woodworkers needed machines to increase production and that he could give them exactly what they needed. The firm of Steptoe and McFarlan soon also began building mortising and tenoning machines that revolutionized the woodworking industry.

George A. Gray (1839-1905) worked as a designer and superintendent for Niles Tool Works before starting his company, the Universal Radial Drill Company. He went on to found the G.A. Gray Company in 1883 to make lathes. Later the company specialized in building planers and became a leading manufacturer of planers.

William Lodge (1848-1917), another Englishman, arrived in Cincinnati in 1872. He worked for John Steptoe until starting his own machine tool business in 1880. In 1886, he took William Davis as a partner. The firm of Lodge and Davis specialized in lathes, planers and drill presses and became the largest builder of machine tools in Cincinnati. In 1891, Lodge founded a new firm, Lodge and Shipley, which specialized in lathes and became the leading lathe manufacturer in the nation.

Richard K. LeBlond (1864-1953) opened a small lathe-building shop on Pearl Street in 1887. When he had any spare time or money, LeBlond worked on a special project: the design and construction of a gun-boring lathe. By 1910, he had achieved his goal; during World War I, the need for a practical gun-boring lathe brought LeBlond his first success. The company went on to become largest builder of crankshaft lathes used by the automobile industry as well as one of the largest machine tool manufacturers in Cincinnati. LeBlond became known as an innovator in the machine tool industry. Prior to the 1890s customers bought their machine from one source, fixtures from another and cutting tools from a third. LeBlond changed this by offering a variety of complete machines, with ready replacement parts. He also diversified by acquiring other companies including the Detroit Aircraft Engine Corporation, Cincinnati Electrical Tool and the Schacht Truck Company.

The Cincinnati Screw and Tap Company was started in the 1870s by Fred Holz and George Mueller to build milling machines and make parts for sewing machines. In 1889, they sold off the screw and tap business in order to concentrate on the machine tools and the name to Cincinnati Milling Machine Company (aka "the Mill"). Frederick A. Geier (1866-1934), who joined the company in 1887, used his skills in organizing, promotion, and sales to build the company from a small shop into the world's largest manufacturers of machine tools. It was under his leadership that Cincinnati-built machine tools earned their reputation for excellence.

Machine tools were elemental in the evolution of modern society. With the development of machine tools that could precisely replicate interchangeable metal parts for a wide variety of products, it became possible to produce consumer goods faster and at less cost. As the cost of products dropped, people had more disposable income to spend on items that were once luxuries, such as cameras, telephones, phonographs and bicycles. Production of an affordable "horseless carriage" was made possible by the development of standardized gauges and jigs and specialized machine tools, such as LeBlond's crankshaft lathe. The acceptance of the typewriter in business offices by the 1890s opened new job opportunities for women.

### **Vocabulary:**

*Machine tool* – a machine that is used to make metal parts used in other machines.

*American system* – mass production of interchangeable metal machine parts.

*Milling machine* – a versatile machine tool that can cut irregular shapes with great accuracy.

*Lathe* – a machine tool that shapes and finishes round pieces of metal.

*Shaper* – a machine tool that cuts on one stroke, repositions the piece and cuts again.

*Planer* – a machine tool that shapes and finishes flat pieces of metal.

### **Focus Questions:**

1. How are machine-made parts different from those made by hand?
2. What machines are located in the machine shop?
3. Name five objects made with parts produced by machine tools.
4. Name three local machine tool companies.