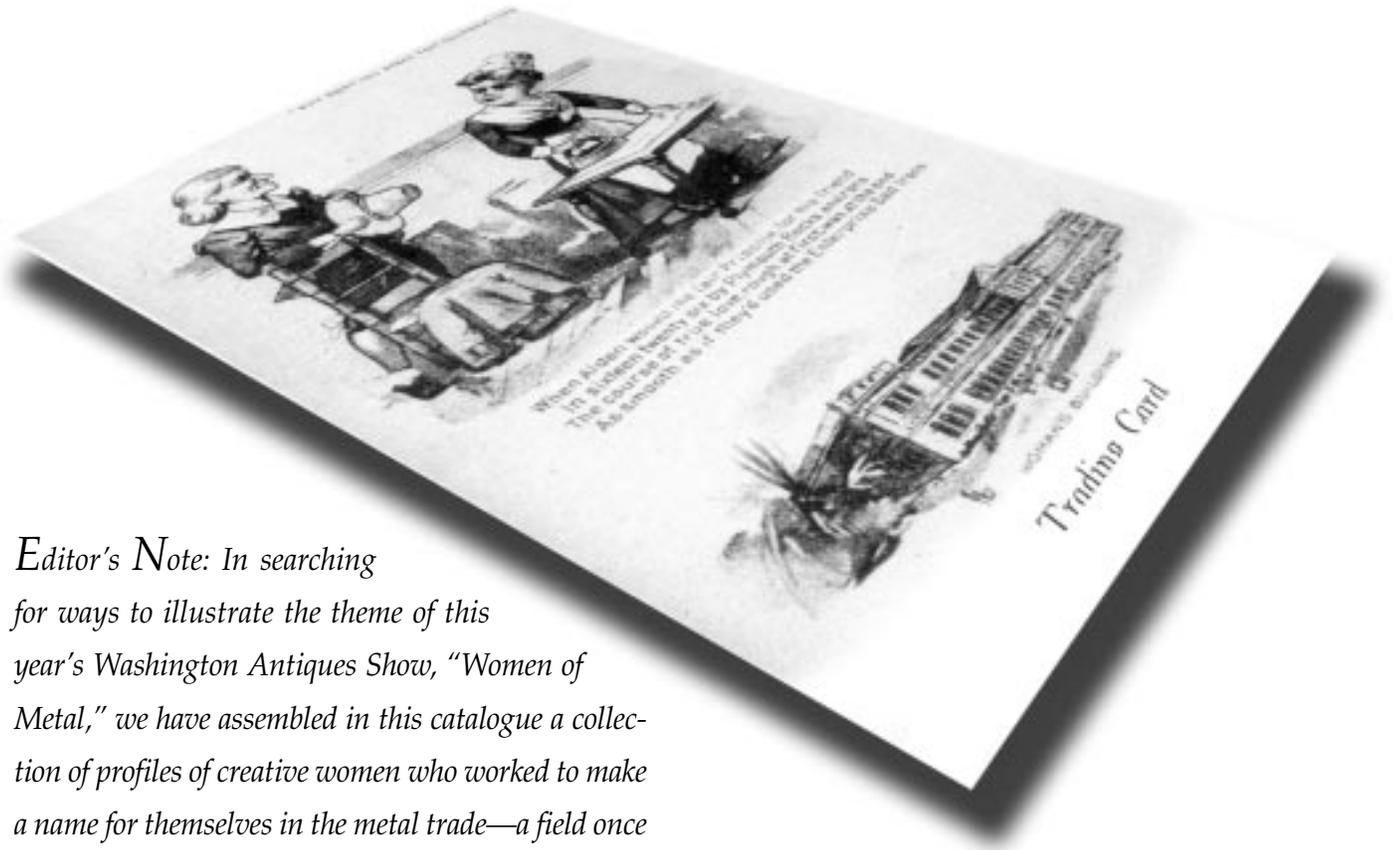


Women of Mettle:

WOMEN INVENTORS CHANGE THE WORLD



Editor's Note: In searching for ways to illustrate the theme of this year's Washington Antiques Show, "Women of Metal," we have assembled in this catalogue a collection of profiles of creative women who worked to make a name for themselves in the metal trade—a field once largely dominated by men. It is clear that these women succeeded in spite of overwhelming odds. In reading the stories of these women from the seventeenth, eighteenth, and nineteenth centuries, we came to regard them as not only "women of metal," but "women of mettle." A chance encounter led us to the following discourse on other "women of mettle"—women inventors. Women are often keen observers who are able to see a need and devise a specific, concrete way to meet that need. Some of our female ancestors were among the earliest patent holders. Women's

BY FRED M. B. AMRAM

inventions—many from the same time period as our "women of metal"—are usually highly practical and thereby very profitable. They can be found in every area from medicine to munitions. We wanted to share with our readers this unusual glimpse of creative women breaking new ground and we sincerely thank author Dr. Fred Amram for allowing us to reprint these selected profiles of women inventors.¹

“I don’t want to go to my grave with knowledge and not do something with it.”

—MARJORIE STEWART JOYNER

BACKGROUND

Inventors change the way we live. All around us are the products of human creativity. The hinges of doors, the plastic of picture frames, the machines that weave rugs, the space vehicles that circle the earth: all are the product of human ingenuity.

Inventions are normally protected as “intellectual property” by different kinds of patents. Utility patents are granted for “new, useful and not obvious processes, machines, compositions of matter and articles of manufacture.” They protect the inventor for 20 years.

The United States has been granting patents since 1790. Since then approximately 5,500,000 patents have been granted and roughly 5 percent include the name of a woman. Clearly women have not been equal partners in the patenting process.²

Women have not been granted more patents for a diversity of reasons some of which are easily identified.

- Patents are property, like real estate, which can be sold and leased. There were times and places in the history of the United States when women could not own property. Consequently, if they created a good idea they might give it to their father, brother, or husband who would then apply for the patent in his own name.
- Even if women were permitted to own property, society often had unwritten norms that suggested that women should be invisible in the worlds of technology and business. Again, women with a new idea might ask a man to apply for the patent.

- New ideas are really improvements on existing technology. Consequently, the inventor must know the prior technology. Until recently women have not had equal access to education, especially in science and technology, and therefore were not familiar with the information they needed in order to be inventors.
- Women have not always had equal access to the tools used to make the models of inventions. Such models were necessary to test whether or not new ideas worked.
- Bringing a new idea to market requires access to money. Because women have historically not had equal access to money, they often did not bother to apply for patents.

And yet women patented! The women who overcame all the financial and social obstacles are worthy of taking their seats next to the Edisons, Bells, and Watts who changed the way we live.

While woman inventors of earlier times left records of their inventiveness in the form of detailed patents, they left little in the way of personal records. Consequently we know little about their personal circumstances. Often we do not even know their exact dates of birth and death. We know enough, however, that we can celebrate their work and identify them as models for future generations.

“Even after English King George I acknowledged the critical role that colonist Sybilla Masters played in the development of Pennsylvania’s economy by citing her [an] inventor..., he nonetheless issued the patent itself to her husband, Thomas Masters.”

—ANNE L. MACDONALD,
FEMININE INGENUITY

grain to make flour. They were often located near natural waterfalls or rapidly flowing water like the Cohocksink Creek.

In the usual “grist mill” operation, the job of the large water wheel was to turn one heavy millstone on top of another in order to crush and grind grain, such as corn or wheat. Carrying the movement of the water wheel to the top millstone required large oak shafts, stone bearings and wooden gears, pinions and cog-wheels to connect the waterwheel to the millstone and make the millstone move with the wheel.

Sybilla’s invention used the same machinery as the old grist mill except, instead of attaching a millstone to the water wheel to grind the corn, she used pestles or mallets which were raised up and down to crush the corn. Power, according to Sybilla Master’s invention, could be supplied either by “beasts of burden” like horses or oxen, or by the traditional water wheel.

Sybilla apparently had observed the Tuscarora Indian women who, instead of grinding their corn with a flat stone, placed the grain into large bowls and beat it with pestles. She adapted this technology by inventing a kind of stamping machine, so that the corn was crushed by an up-and-down movement—a mechanical adaptation of the way Indians crushed it using mallets which they operated by hand.

According to the inventor, the end product was “easy to transport.” She also reported that it was good for treating illnesses such as “consumption.” This was a common name given to chronic illnesses, especially diseases of the lungs, like tuberculosis, that caused people to gradually grow weaker. It was common at the time to add claims, particularly health claims, to products that were simply improved in texture or taste.

Masters also invented a new way for weaving, staining, and decorating straw hats. Many women at the time worked as hat makers and seamstresses in addition to their field and home chores. Straw hats were the fashion of the day for both sexes. Again, to make her products more marketable she decided to invent a better hat.

Then as now, it was not enough to have good ideas. To succeed in business, you had to protect your rights to profit from inventions. There was no U.S. Patent law then to keep others from using your new techniques. There was only English law. Inventors wishing government protection to keep others from using their ideas could apply to King George for a patent granting protection. This document could be shown if there was any argument about rights, whether in the mother country or in the colonies ruled by England.

Sybilla must have been courageous, confident and ambitious. In 1715, she boarded a sailing ship to cross the ocean with drawings and descriptions of new ideas. After arriving in England, she would have to convince the king’s lawyers of the value of her work. She would have to answer many technical questions and prove that she had invented the techniques herself. She came home many months later with British Patent No. 401, granted by the king to Thomas Masters, of Pennsylvania, for “A New Invencon found out by Sybilla, his Wife, for Cleaning and Curing the Indian Corn Growing in the severall Colonies in America.”

Later she received British Patent No. 403, also granted to Thomas on behalf of his wife Sybilla, for “A New Way of Working and Staining in Straw, and the Platt and Leaf of the Palmeta Tree, and covering and Adorning Hatt and Bonnett, in such a Manner as was never before Done or Practised in England or Any of our Plantacons.”

These documents gave the couple “full power, sole privilege and authority” to profit from the inventions wherever the British ruled. While Sybilla was away, Thomas built a mill in Philadelphia to use the new method of cleaning and drying the grain. On her return, they began a profitable business.

Thomas Masters and his wife, Sybilla, profited from her inventions. Much later, Thomas Masters became one of the early mayors of Philadelphia and a prominent citizen. ♦

Margaret Knight

MARGARET KNIGHT (c. 1838–1914)

Built a career as an inventor with at least 23 patents for diverse products including window frames, improvements in engines, machines for cutting shoe soles and machinery for folding and gluing square-bottomed paper bags.

Raised in Manchester, New Hampshire, she lived most of her adult life in Framingham, Massachusetts. Born ca. 1838 and died October 12, 1914; never married; mostly self taught.

Maggie Knight certainly was an unusual child. After she became a celebrated inventor and a role model for other women, she said in an interview:

As a child I never cared for things that girls usually do; dolls never possessed any charms for me...the only things I wanted were a jack-knife, a gimlet, and pieces of wood. My friends were horrified. I was called a tomboy; but that made little impression on me. I sighed sometimes because I was not like other girls; but wisely concluded that I couldn't help it and sought further consolation from my tools. I was always making things for my brothers: did they want anything in the line of playthings, they always said, "Mattie will make them for us." I was famous for my kites; and my sleds were the envy of all the boys in town.

Knight began working in the Manchester, New Hampshire, cotton mills at the age of nine or ten. Child mill-workers were common in some New England towns looking for cheap labor. Children from poor families were placed in the mills to add to the family income.

While working in the cotton mill she allegedly invented a shuttle restraining device after seeing a worker injured when a sharp, steel tipped shuttle fell from a loom. There is no record that young Maggie

received a patent but safety shuttles were implemented around that time.

In her late teens she learned photography, engraving and upholstery skills as she moved from job to job to support herself. She became interested in the problem of paper bags while working for the Columbia Paper Bag Company in Springfield, Massachusetts.

Before the 1870s, customers carried their groceries in net bags, cardboard boxes or even wooden boxes. What paper bags existed were shaped like envelopes and, therefore could not hold much—or, if they had a flat bottom they were made by hand. For years men had been trying to design a machine that could make a bag with a flat bottom that could be manufactured inexpensively. Unfortunately, the bag had to be folded and glued by hand—a tedious process.

Knight spent many months working out her ideas for a machine that would make a square bottom bag. She made many drawings, tried out the design on a wooden model, and finally had an iron model made to her specifications. A man who had seen her work, Charles F. Annan, beat her to the patent office. She filed a suit against him, claiming that he had copied her idea.

During the court battle, Annan and his lawyers tried to convince the court that Knight, being a woman, could not possibly have enough knowledge of machinery to design such a sophisticated machine. Fortunately, many people told the court they had been involved in the various phases of her work, from early discussions, writings and drawings to the final machine. As a result, she won her case, and received her patent in 1870.

Knight and a Newton, Massachusetts, businessman set up the Eastern Paper Bag Company in Hartford, Connecticut, to profit from the machine. When she was invited to help install the machine in the factory where the bags were to be made, the workers would not listen to her advice, saying, "What does a woman know about machinery?"

*“After all, what does a woman know
about machinery?”*

—WORKERS WHO WOULD NOT ACCEPT MARGARET KNIGHT’S ADVICE
WHEN INSTALLING A MACHINE SHE HAD PATENTED.

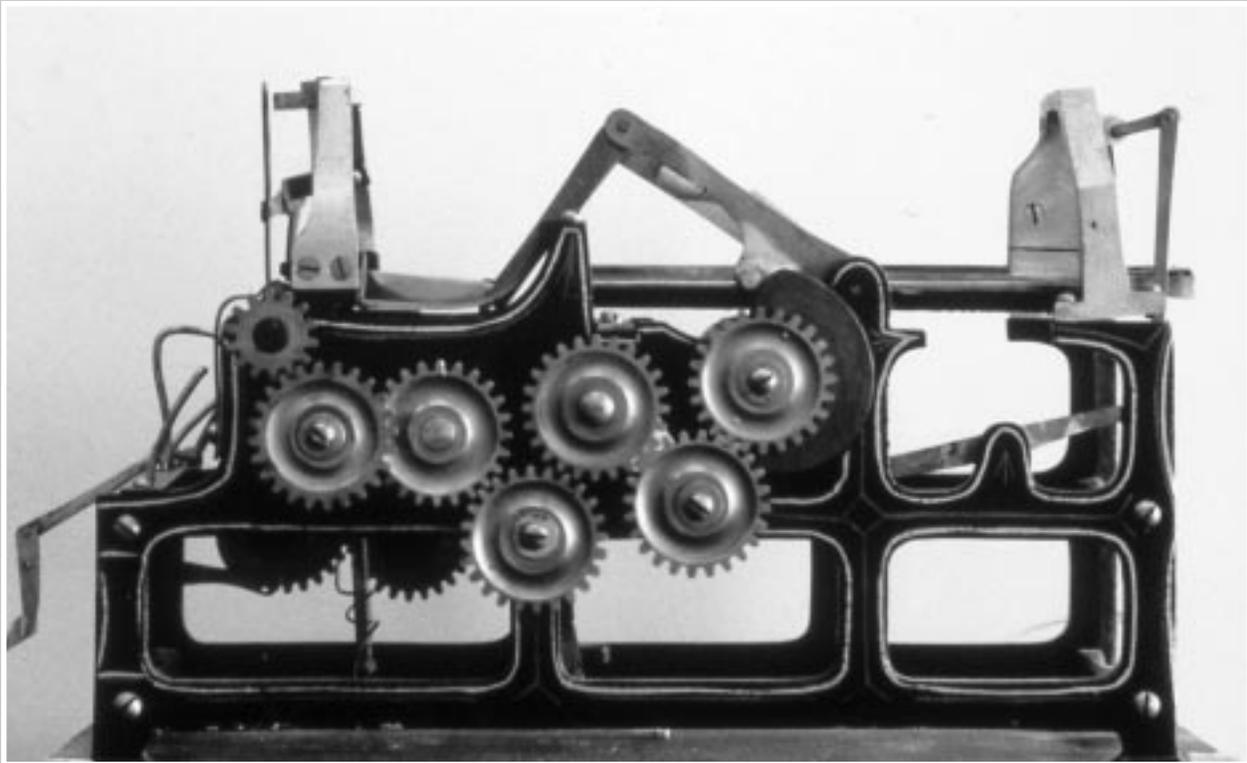


FIGURE 2.
A model of Margaret Knight's machine for the manufacture of square-bottom paper bags. (Photo by Sandra A. Brick.)

The machine, and several later improvements, became hugely popular. It was reported that the machine could do the work of thirty humans. Certainly it made square-bottomed paper bags inexpensive to make and use. That changed the way people shopped for groceries—and eventually for many other products.

Margaret Knight went on to receive at least 23 patents. Her inventions included internal combustion engines, a resilient wheel, machinery for cutting shoe soles, and a window frame and sash.

The *Framingham Evening News* (October 13, 1914), one day after her death at the age of 75, reported that Miss Knight's machinery for making and folding square-bottom paper bags was still in use 35 years after the patent was granted. In an obituary announcing her death, a Boston newspaper referred to Knight as “the woman Edison.”❖

Marjorie Stewart Joyner

MARJORIE STEWART JOYNER (1896–1994)

Inventor, entrepreneur, political activist, and philanthropist supporting African American causes.

Granddaughter of a slave; her mother worked as a maid; married Robert Joyner, podiatrist; received two patents; became a vice president of the Walker Company.

If “Black is Beautiful,” Marjorie Stewart Joyner helped to make it so. She started as a beautician, moved on to becoming an inventor and business executive, and dedicated her life to racial and gender equality in Chicago’s black community and throughout the United States.

Marjorie Stewart, born in Mississippi, the granddaughter of a slave, came to Chicago to be with her divorced mother who had moved north to become a maid. She married Robert Joyner who became a doctor of podiatry. After achieving success as an inventor and entrepreneur, she decided, after retirement to return to school to earn a Ph.D. in the humanities.

Early in her career, Marjorie Stewart worked in a beauty parlor where she was trained to style white women’s hair. After she married Mr. Joyner she tried to impress her new mother-in-law by providing free hair care. The elder Mrs. Joyner however was not impressed, pointing out that young Marjorie knew nothing about styling the hair of African Americans. Her mother-in-law recommended that Marjorie study at one of the Walker schools, a chain which had been developed by Madame C. J. Walker.

Marjorie Joyner learned quickly that tight, kinky hair needed special treatment. Further, she learned that at the time black women preferred to have their hair “curled.” That meant removing the kinky quality with

various types of straighteners. That, of course, was at a time before the current fashion of keeping the hair more “natural.”

The process for “curling” or “waving” hair usually meant heating a curling iron that looked very much like a pair of dull scissors. At first the irons were heated in or on a stove. After electricity became popular the irons were heated internally. It was a slow, uncomfortable process. Each curl had to be set—one curl at a time. A hank of hair was placed in the scissor grip. Then the iron was twirled to create the curl. Each hank had to set for a while.

Joyner reasoned that the process would be much more efficient if one were to hang a group of curling irons from above. Each clip could capture a hank of hair and the entire machine could be plugged into an electric outlet. An entire head of curls or waves could be set at once. Thus was born Joyner’s Permanent Waving Machine. The 1928 patent was assigned to the Madame C. J. Walker Manufacturing Company and was used in the entire chain of Walker beauty salons and schools. It became a huge success.

Whether one used individual curling irons or the new Permanent Wave Machine, the process was uncomfortable for the person whose hair was being waved. The irons or clips were hot and pinched the scalp. In 1929 Joyner patented a Scalp Protector to

make the “curling” process more comfortable. This patent was also assigned to the Walker Company.

The Waving Machine had an unexpected new market. While black women wanted to change the kink to a curl, white women wanted to add curl to their straight, often stringy, hair. Pretty soon beauticians serving the much larger white market wanted the Joyner Permanent Wave Machine.



FIGURE 3. Marjorie Joyner, inventor of the Permanent Waving Machine in her later years. (Courtesy of the DuSable Museum, Chicago, Ill.)

“The object of the invention is the construction of a simple and efficient machine that will wave the hair of both white and colored people.”

—MARJORIE JOYNER IN HER FIRST PATENT APPLICATION

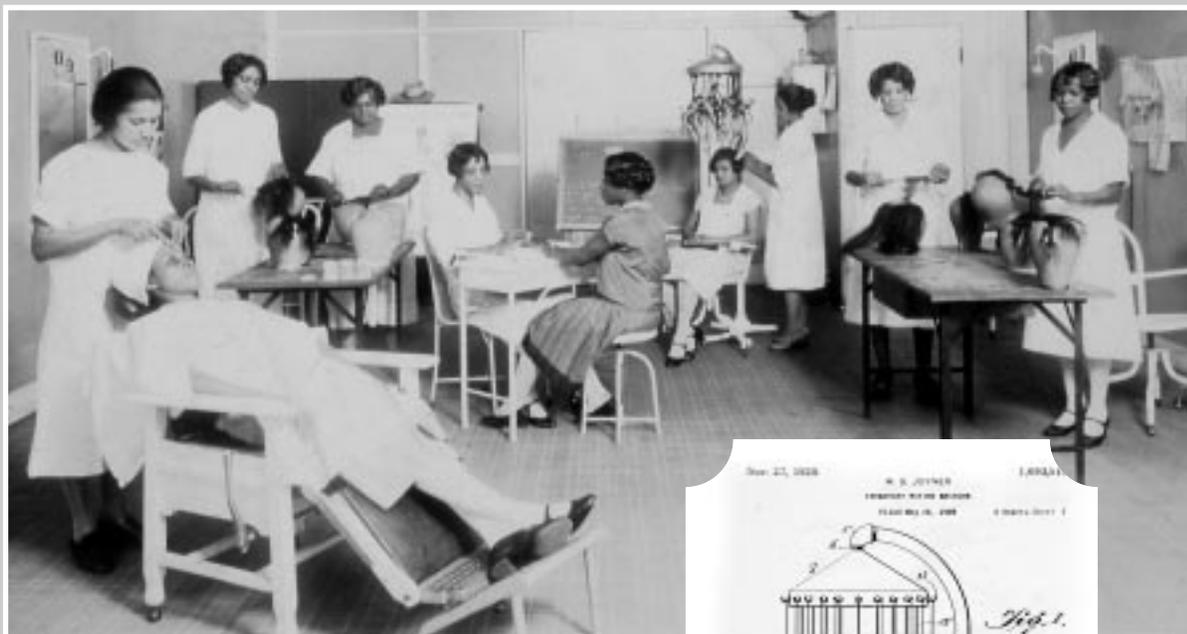


FIGURE 4.
The Permanent Waving Machine in use in a beauty salon owned by Madame C. J. Walker. (Courtesy of the Vivian G. Harsh Research Collection of Afro-American History and Literature, Chicago Public Library, Chicago, Illinois.)

Soon Joyner was selected for the Board of Directors of the Walker Company. She had a knack for the business and became vice president of a national chain of 200 Walker beauty colleges. In the 1940s Joyner founded the United Beauty School Owners and Teachers Association. Her work was featured as part of a 1987 Smithsonian exhibition.

Marjorie Joyner, along with her mentor, Madame C. J. Walker, had a real impact on the beauty industry. Joyner used her profits to become a generous philanthropist, contributing to African American societies that served children and the arts.

Joyner died just after Christmas in 1994 at the age of 98. She was remembered for her public service including membership on President Franklin Roosevelt's campaign committee. Joyner worked with Mary McCleod Bethune and Eleanor Roosevelt on issues that concerned women and the African Ameri-

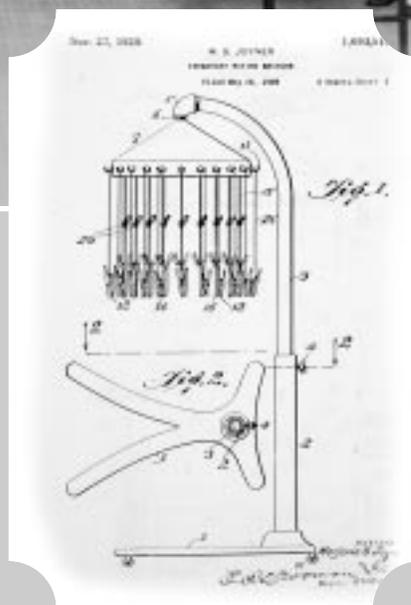


FIGURE 5.
Patent drawing of Joyner's Permanent Waving Machine.

can community. But most of all we remember her for her contributions to beauty. Clients at her beauty shop included Billie Holiday, Lena Horne, Ethyl Waters, Marion Anderson, and Louis Armstrong.

At the age of 93, she was saluted by *The Washington Post* as the “Grande Dame of Black Beauty Culture.” On hearing of Marjorie Joyner's death, Illinois Senator Carol Mosely-Braun said, “Dr. Joyner proved that excellence, discipline and commitment will win out in the long run.” ♦

Mary Florence Potts

MARY FLORENCE POTTS (C. 1853–??)

Inventor of the most popular irons ever used and holder of four patents.

Father was a plasterer in Ottumwa, Iowa; married to Joseph Potts with whom she jointly held one patent for a medical device; three patents granted to Potts for improvements in sad irons.

Ms. Potts' father was a plasterer; consequently she had special knowledge about using plaster to make a mold and about its properties. She used plaster as a core because, she reasoned, the tool need not be solid iron. If the central part were plaster, it would be cooler on the knuckles. She built a plaster mold and asked a local foundry to put a relatively thin layer of iron on the sides and a heavier layer on the bottom, where it was needed to hold the heat and to press the fabric.

Imagine young Mary Florence Webber as a teenager living in Ottumwa, Iowa. Surely, like most girls her age she had to help with the household chores. Certainly that included ironing on Tuesday (because Monday was usually wash day). This was before the invention of cotton wash-and-wear clothes (invented by Ruth Benerito). We see a 17-year-old Mary Webber married to Joseph Potts. She was 18 when she gave birth to a son, the first of six children, and only 19 years old when she received the first of her patents.

Pressing clothes has a long and interesting history. Just before the modern, electrically heated, iron was invented, the devices were made of solid iron from which we get the term "ironing." They were called "sad

irons" because "sad" is an archaic word for "heavy." The devices were placed on a stove until they were hot enough to help in the smoothing process. Irons cooled quickly and required the user to press down heavily on the material to be smoothed (hence pressing). The solid iron base, often attached to an iron handle, caused great discomfort to the hand. The problems of ironing were particularly evident to women who did most of the work. The solutions often came from woman inventors.

The solid, externally heated iron has gone through a long history of modifications. An early improvement replaced the iron handle with a wooden one. This made "handling" the iron somewhat cooler because the wood did not retain heat as easily. However, while the iron was heating on the stove, the wooden handle sometimes charred, thus weakening the handle's structure. Furthermore, women often wrapped cloth around their knuckles to protect them from rising heat while ironing. Julie Ditrach patented one solution to the problem in 1866. She proposed a leather heat deflector or shield suspended from a detachable handle. It is noteworthy that the manufacturer of the Anna Niffeler charcoal-heated tailor's iron (design patent, 1868) included a metal heat shield between

the handle and the grip.

Surely the most popular sad iron available was the double pointed iron with detachable handle patented by Mary Florence Potts. The iron was manufactured by many companies in the United States, Canada, and Europe. It became the standard of the industry and certainly the most popular sad-iron ever made.



FIGURE 6.
An image of Mary Florence Potts on a trade card. Note the language at the bottom of the card referring to herself as "inventress"—a Victorian expression.

“...Wash day with its sequel of “ironing” was to Miss Mary, as to many other daughters of Eve, a time of tribulation.”

—SATURDAY HERALD, OTTUMWA, IOWA, MAY 27, 1899



FIGURE 7.
Trade card advertisement
for the sad iron designed
by Potts.

The body of the Potts iron was cast hollow (rather than solid) and the bottom had a thicker layer of iron than the sides. It was filled with material that was a non-conductor of heat, such as plaster of paris, cement, or clay. Consequently, not as much heat would radiate up as from earlier irons. Potts also claimed in her 1870 U.S. patent (reissued in 1880) that her iron held the heat longer so that more articles could be ironed without reheating the iron. Another advantage of this solid one-piece double-pointed sad iron was that one could iron in either direction. A rounded handle made the tool more comfortable for the wrist.

Mary Potts' masterpiece was the detachable handle patented in 1871 (reissued in 1872 and 1879). She designed a mechanism that permitted the user to place the iron on a hot stove and remove the handle so that

the handle would stay cool. Indeed, it was easy then to heat several bases at once, pick up the base which was most hot—or even one of a different size, more appropriate for the task—and continue to work with the cool handle.

Potts' inventions were licensed to many companies, and even after the patents had elapsed, the products continued to be manufactured throughout the world—well into the twentieth century. Her irons are still in use in areas of Africa and South America where electricity is not available.

The Potts irons with their separate and replaceable handles became so popular that by 1891, special machines were invented that could produce 12,000 to 15,000 semicircular wood handles in a single day rather than the three or four hundred handles produced daily

FIGURE 8.
The Potts cool-handled
iron showing one handle
and two bases.



Mary Florence Potts Continued

with earlier technology. Many men received patents for base and handle adaptations. For example, patents were granted for charcoal, gas, and electrically heated irons, all having Potts' detachable handle. The man receiving the charcoal iron patent even states, "The construction and operation of the detachable handle is well known as the Potts sad iron and need not be described more fully." As late as 1920, a design patent was granted to a man for a carved design on Potts' handle.

The inventor had special access to the problem because, as we learn from the *Saturday Herald*, Ottumwa, Iowa, May 27, 1899,

wash day with its sequel of 'ironing' was to Miss Mary, as to many other daughters of Eve, a time of tribulation. That old iron with its solid metal handle, needing always a 'holder', and then scorching the clothes and scorching the hand was a nuisance.

The *Herald* reported that Mary "would try an experiment..." A paste board rim was prepared and put around the top of the iron, and then the enclosure filled with plaster of paris. That protected the hand from the heat. Then it seemed to her that the shape of the iron could be improved. And lastly the iron handle was disposed and replaced with a wooden, detachable handle. Such was the invention.

Mary and Joseph Potts tried to manufacture and sell the newly patented irons as "Mrs. Potts Iron" attesting to the fact that a woman had invented and tested the product. Female customers certainly could trust that endorsement. Nevertheless, the effort failed and they filed for bankruptcy. Subsequently they started over in Philadelphia where the American Enterprise Company took over the iron's manufacture and distribution. Soon other companies throughout the world were selling the product (or imitations) and it became a huge success. Mrs. Potts irons were manufactured from 1871 until 1951. They were featured at the 1876 American Centennial and became an instant hit. To this day antique collectors value the product of Mary Potts' ingenuity.

In 1892 Mary and Joseph received a joint patent for a "Remedial or Medical Appliance." The device is an early version of a heating pad, flexible so that it is comfortable on the body and heated externally. The device, of course, predates electric heating pads.

Interestingly, Joseph Potts received a patent for a Spring for Bed Bottom which he assigned to his young wife, Mary. This was two months before her Sad Iron patent was granted. Perhaps Joseph assumed from the start that Mary would be the entrepreneur of the family.❖

Dr. Fred M. B. Amram is an inventor and Morse Alumni Distinguished Professor Emeritus of Creativity and Communication at the University of Minnesota. He has authored books and articles on creativity, women's ingenuity, robotics, and communication. Professor Amram has been curator of exhibitions throughout the U.S. displaying the achievements of women inventors.

PHOTOGRAPHS

Unless otherwise noted, all images are courtesy of the Amram/Brick Collection.

NOTES

1. Excerpted from *Women in World History*, by Dr. Fred Amram, vol. 7, pp. 673–680. ©The Gale Group, Farmington Hills, MI. Reprinted by permission of The Gale Group.
2. Author's update: This article, written in 1998, is now somewhat outdated. Woman inventors have made great strides in recent years. During 2002, roughly 12 percent of U.S. patents included the name of a woman. That would increase the average since 1790 to over 7 percent. Nevertheless, women have a long way to go to achieve parity in inventing statistics.

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