



AMERICAN
INSTITUTE FOR
CONSERVATION
OF HISTORIC AND
ARTISTIC WORKS

Article: Looking at guilloché in conservation

Authors: Brittany Nicole Cox and David Lindow

Source: *Objects Specialty Group Postprints, Volume Twenty-Three, 2016*

Pages: 162-178

Editors: Emily Hamilton and Kari Dodson, with Laura Lipcsei, Christine Storti, and Leslie Friedman, Program Chairs

ISSN (print version) 2169-379X

ISSN (online version) 2169-1290

© 2018 by The American Institute for Conservation of Historic & Artistic Works

727 15th Street NW, Suite 500, Washington, DC 20005 (202) 452-9545

www.conservation-us.org

Objects Specialty Group Postprints is published annually by the Objects Specialty Group (OSG) of the American Institute for Conservation of Historic & Artistic Works (AIC). It is a conference proceedings volume consisting of papers presented in the OSG sessions at AIC Annual Meetings.

Under a licensing agreement, individual authors retain copyright to their work and extend publications rights to the American Institute for Conservation.

This article is published in the *Objects Specialty Group Postprints, Volume Twenty-Three, 2016*. It has been edited for clarity and content. The article was peer-reviewed by content area specialists and was revised based on this anonymous review. Responsibility for the methods and materials described herein, however, rests solely with the author(s), whose article should not be considered an official statement of the OSG or the AIC.

LOOKING AT GUILLOCHÉ IN CONSERVATION

BRITTANY NICOLE COX AND DAVID LINDOW

Guilloché, also referred to as engine turning, is work produced on a rose engine or straight-line engine. The rose engine was developed in the 16th century but found wide-scale popularity in the early 19th century when Breguet applied the craft to augment his watch dials, cases, and movements; many believe it reached its apex with Fabergé. Conservation methodology for guilloché work appears to be a relatively new subject, and understanding the processes by which an object was made or decorated may be the first stage in development. Little information is widely available on the rose engine, and even less is available on the process by which its patterns are created. In this article, we briefly explore the history of these machines and their various uses through examining the steps required for accomplishing distinct patterns and looking at some of the diverse objects that employ them. The rose engine was employed not only in horology to decorate metal objects of art but also in other media, such as pottery by Josiah Wedgwood and modern plastic injection molding patterns. As these machines were used from the early 16th century into the present, many conservators are likely to encounter objects that were either made or decorated by them.

A link is provided to an additional resource in which the reflective quality of guilloché work along with the effects of oxidation on this property is examined, and through this the various pitfalls in the practice of cleaning and repair are identified. Further, 60 common guilloché patterns are cataloged.

KEYWORDS: Guilloché, Engine turning, Rose engine lathe

1. INTRODUCTION

The rose engine lathe is an enigma to all but a small group of artisans who use it, despite being employed in a broad scope of work from decorative ivories to pottery, clocks, watches, and snuff boxes, as well as glass molds, the printing of stamps and stock certificates, and plastic injection moldings. Although the practice has been so widely used, the techniques employed by these machines are seldom explained in books or other publications. Often the use of the rose engine to decorate an object is not mentioned, even in instances where the machine was used to decorate the entire piece. In conservation, a working knowledge of how an object was made is not only useful but crucial. Given the scant scholarly work on the subject, we endeavor here to scratch the surface and give a brief account of both the machine's history and how it was used, in the hopes of fostering further study. To this end, we conducted a literature review, produced a catalog of 60 common patterns, and prepared and treated 28 metal samples. These samples consist of composition 353 brass, nickel silver, and fine silver. They were treated with common nonconservation-based approaches to show how patterns can be distorted, and to demonstrate the effects of oxidation on the reflective surface. It is our hope that this will spur discussion about how to better treat these highly reflective metal surfaces, as the characteristic flash of guilloché is arguably its most important tangible property.

Guilloché, or engine turning, is a form of mechanical decorative engraving that is found on a variety of materials, such as metals, clay, glass, bone, and wood. The patterns are produced on a rose engine or straight-line machine and can be applied directly to the surface or transferred by use of a mold or other method.

2. HISTORY

The earliest known printed account of turning in English included a description of the rose engine lathe and was written by Joseph Moxon in his book *Mechanick Exercises: Or, the Doctrine of Handy-Works* (1989), originally published in 1683. Moxon had seen the copper engravings of a rose engine used in Fe'libien's *Des Principes de l'Architecture*, published in 1678 (Maurice 1985; Moxon 1989). In 1701, Charles Plumier, a friar and botanist who had been encouraged to take up turning by his father,

published a practical book in French dedicated to turning. Plumier's book superseded Moxon's book in usefulness and reigned as "the classic book on turning for 100 years—until Bergeron" (Maurice 1985, 105–106). This was a watershed period for the rose engine, as by the 18th century the "Engine Turner" was almost exclusively the practitioner of the rose engine producing "fine line" work on metal (Matthews 1984, 9). However, to begin this history with Moxon and Plumier is to leave out roughly a century and a half of the machine's use. A *Box in the form of a rose, with a miniature portrait of Anne of Cleves*, ca. 1539, can be seen in the collection of the Victoria and Albert Museum, as seen in figure 1.

The turned portion of the piece is ivory, which was the choice turning material of craftsmen during this period. By the late 16th century, men like Georg Friedel and Jakob Zeller, both from Dresden, were employing the rose engine lathe to turn highly complex compositions (Maurice 1985; Syndram and Scherner 2004; Syndram 2010). One of the largest collections of this type resides at Pitti Palace in Florence; this group of 27 turnings was taken from Coburg, Germany, as spoils during the Thirty Years' War and has remained intact to this day (Piacenti 1989). Although ivory was an exceedingly popular material at this time, wood objects were also turned on the rose engine lathe. Two examples can be seen in the collections of the Victoria and Albert Museum, as shown in figures 2a and 2b.

By the middle of the 17th century, the use of the rose engine lathe had spread across western Europe, and the avocation of rose engine turning remained common among sovereigns until the late 18th century (Maurice 1985). Bergeron published his treatise on turning, *Manuel du Tourneur*, in 1792 and 1796; the world would not see another such instruction manual for almost 200 years (Maurice 1985).

During the 18th century, the rose engine became the tool of the tradesman, and guilloché work on metal became the primary application (Matthews 1984). Despite this, the rose engine's use broadened; decorated objects made from such materials as agate (see <http://collections.vam.ac.uk/item/O156317/snuffbox-unknown/>), ceramic, pewter (figs. 3a, 3b), and even buttons can be seen.

Josiah Wedgwood introduced engine turned decoration to his ceramics in 1763. Wedgwood would continue to use the rose engine for decoration, as shown in promotional films from the 20th century (see <https://www.youtube.com/watch?v=DDDBQh8YpfA>). The diverse use of the rose engine



Fig. 1. Hans Holbein and unknown artist, *Box in the form of a rose with a miniature portrait of Anne of Cleves*, ca. 1539, ivory, card, watercolor, vellum, diameter of box: 6.1 cm, diameter of lid: 5.95 cm, Victoria and Albert Museum, P.153: 1, 2-1910 (Courtesy of Victoria and Albert Museum)

a



b



Fig. 2a. A wassail bowl made in England with engine turned decoration. Unknown, *Wassail bowl*, 1640–80, Lignum vitae, ivory, height: 50 cm, Victoria and Albert Museum, W.8A to C-1976; 2b. A cup case made in Denmark with engine turned decoration. Unknown, *Cup case*, 1643, pearwood, height: 205 mm, diameter: 100 mm, Victoria and Albert Museum, W.20:1-1969 (Courtesy of Victoria and Albert Museum)

a



b



Fig. 3a. Wedgwood, *Vase*, 1764–65, earthenware, height: 18.4 cm, diameter: 11.4 cm, Victoria and Albert Museum, C.6-2010; 3b. Detail of turned button decorating a coat. Unknown, *Coat*, 1750–59, pewter, dimensions unknown, Victoria and Albert Museum, T.962-1919 (Courtesy of Victoria and Albert Museum)



Fig. 4. An étui made in Paris: “This basse-taille technique first appeared in Parisian goldsmith’s work ca. 1768, after the introduction of the rose-engine lathe” from item description. Toussaint-François Pillieux, *Étui*, 1785–86, gold and enamel, dimensions unknown, The Metropolitan Museum of Art, 95.14.42a, b (Courtesy of the Metropolitan Museum of Art)

applied by Wedgwood can be readily understood through examining the company’s catalog of work (Reilly 1989).

By the middle of the 18th century, guilloché patterns had become rather elaborate and were often overlain with enamel (see <http://collections.vam.ac.uk/item/O156448/snuffbox-unknown/>). By 1768, the basse-taille technique of covering engine turned gold and silver with translucent enamel had come to Paris along with the introduction of the rose engine (fig. 4).

Examples of highly elaborate boxes and objects made in the third quarter of the 18th century using this technique are shown in figure 5.

It can be seen in figure 5 that the engine turned cuts do not include more complex designs as seen on later work, where the cuts “cross” each other to create composite patterns. To accomplish this would require a “crossing plate,” which lathes such as those shown by Moxon lacked (Daniels 2002; Moxon 1989). However, by ca. 1760–70, crossing plates are seen on rose engines, such as those owned by Louis XVI (Maurice 1985). Additionally, the straight-line engine and a straight-line chuck (an attachment for the rose engine) appear around this time (Matthews 1984). The introduction of elliptical and eccentric chucks also added to the variety of possible patterns, as shown in figures 6a and 6b (Matthews 1984). Guilloché continued gaining popularity with craftsmen, and examples of engine-decorated snuffboxes, musical boxes, singing bird boxes, and many other objects appeared (figs. 6c, 6d).

From about 1790, engine turned objects found their way into popular circulation, likely owing to Abraham-Louis Breguet’s influence, which led to a wide use of basse-taille. Breguet’s watches “set a standard of thinness, elegance, simplicity, robustness and good timekeeping that make them sought all over Europe, including Russia” (Clinton and Daniels 1965, 79–83). His prominent style is depicted in the example shown in figure 7.

Contemporary watchmakers, such as Roger Smith, still use Breguet’s work as a standard of excellence. Breguet’s trademark silver dials were often bleached, producing a whitish, matte surface that accentuates the engine turning. However, this finish is susceptible to degradation, and recovery is difficult, if not impossible. Craftsmen contemporary to Breguet manufactured objects with both guilloché and enamel; however, Breguet’s work into the 19th century set the bar for watches of this era and the guilloché on them.

In 1819, Joseph Perkins obtained a patent for a machine to engine turn security notes as a means to discourage forgery, and by ca. 1824 engine turning had found its way into the Calico printing industry

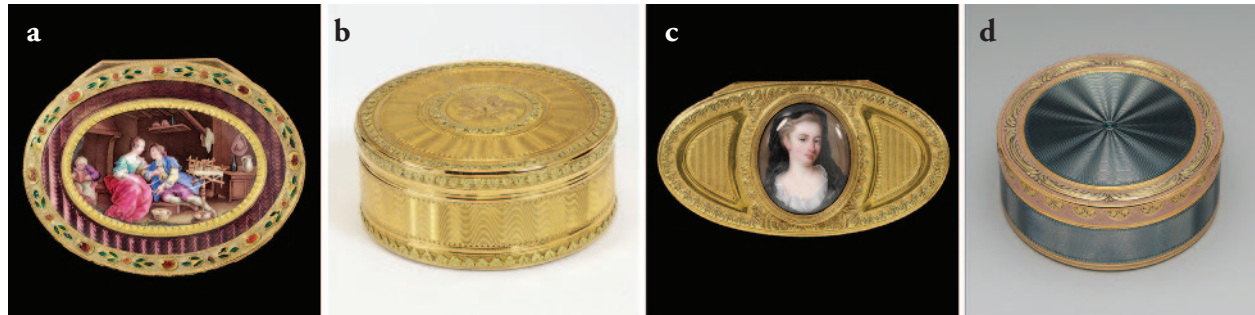


Fig. 5a. Nicolas Ménière, *Box*, 1773–75, gold and enamel, 6.99 x 5.59 cm, Victoria and Albert Museum, 915-1882 (Courtesy of Victoria and Albert Museum); 5b. Jean-Joseph Barrière, *Box*, 1771–72, gold, 2.7 x 6 cm, Victoria and Albert Museum, 180:18&:2-1864 (Courtesy of Victoria and Albert Museum); 5c. Bouillerot, Charles Alexandre (maker) and Zincke, Christian Friedrich (painter), *Box*, 1771–74, gold and enamel, 4 x 8.9 x 4.7 cm, Victoria and Albert Museum, 151-1878 (Courtesy of Victoria and Albert Museum); 5d. Charles Le Bastier, *Snuffbox*, 1773–74, gold and enamel, 3.2 x 7.3 cm, The Metropolitan Museum of Art, 17.190.1163a, b (Courtesy of the Metropolitan Museum of Art)

(Matthews 1984). By 1840, the “Penny Black” postage stamp, which featured engine turning for the first time, was introduced to England (fig. 8).

Another notable figure is Peter Carl Fabergé (1846–1920) who, like Breguet, utilized engine turning on his popular works. In 1872, Peter Carl took over his father’s workshop and was joined by his brother, who heavily influenced production, in 1882. Fabergé’s work took a significant change in direction in 1884–85, when he replaced the head work-master. With this new style came fans, opera glasses, snuffboxes, bon-bonnières, scent bottles, *cartes de bal*, parasol and cane handles, seals, and entire toilet services. These objects, along with the imperial Easter Eggs for which he is most well known, also saw production in 1884. These pieces often incorporated high-quality enamels with engine turning underneath. This set the work apart from that of his contemporaries, and the technique was continued until the dissolution of the firm in 1917, following the Revolution in Russia. In 1918, Fabergé fled to Switzerland, where he died two years later (Bainbridge 1979; Habsburg-Lothringen and Curry 1996).

Wedgwood and others continued to utilize the rose engine, and many notable watch companies employed engine turning on cases (figs. 9a, 9b, 9c), whereas clockmakers used it for dial designs into the 20th century (fig. 9d).

La Chaux-de-Fonds became an important area for engine turning as watches like those depicted earlier gained popularity. This led to companies such as Lienhard to begin production of trade-style rose engine lathes, straight-line machines, and closely related brocading engines (Matthews 1984). In England, George Plant & Son manufactured engine turning machines beginning in 1857. Although Swiss and English machines were likely found in the factories, Charles Field led the way in making

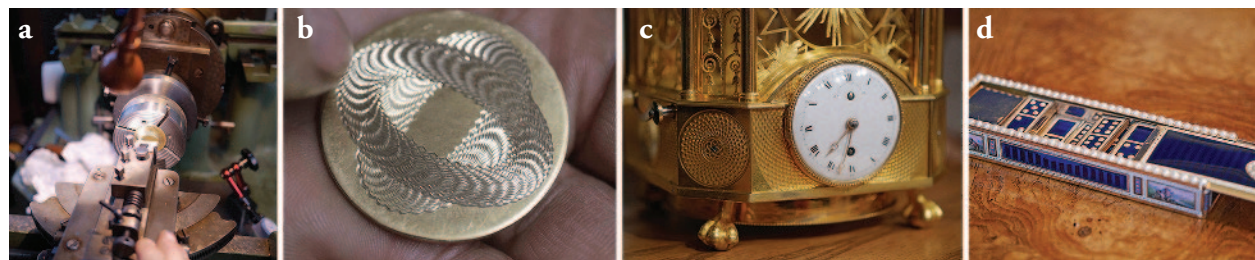


Fig. 6a. Use of the elliptical chuck (Courtesy of Brittany N. Cox); 6b. Elliptical “rope” pattern overlay (Courtesy of Brittany N. Cox); 6c. A mercury gilded birdcage automaton with engine turning, late 18th century (Courtesy of Ken Goldman); 6d. A 19th century gold and enamel box and domino set decorated with engine turning (Courtesy of Ken Goldman)



Fig. 7. A watch by Breguet with an engine turned dial and case. Abraham-Louis Breguet, *Watch*, 1798–1809, gold, 4.7 x 4.2 x 0.8 cm, height with suspension loop: 5.3 cm, Victoria and Albert Museum, M.19-1957 (Courtesy of Victoria and Albert Museum)



Fig. 8. The Penny Black mark and image is a registered trade mark of Royal Mail Group Limited. Reproduced with kind permission of Royal Mail Group Limited

engine turning equipment in America, specializing in rose engines, straight-line engines, and brocading engines (fig. 10).

In a lecture given at the Ornamental Turners International symposium in 2012, Peter Dicristofaro, curator of the Providence Jewelry Museum, presented a paper concerning the American watch and jewelry industries and their approaches in the manufacture of clad metals. This talk remains unpublished, but according to Dicristofaro, American methods significantly reduced costs for tradesmen and also managed to retain the same aesthetic in their products as with precious metals. Looking to further reduce costs and industrialize a luxury market, they explored techniques for imitating engine turning while reducing the amount of precious metals previously used in production. To this end, they developed press tools and operations that achieved a finish often hard to distinguish from authentic engine turning.

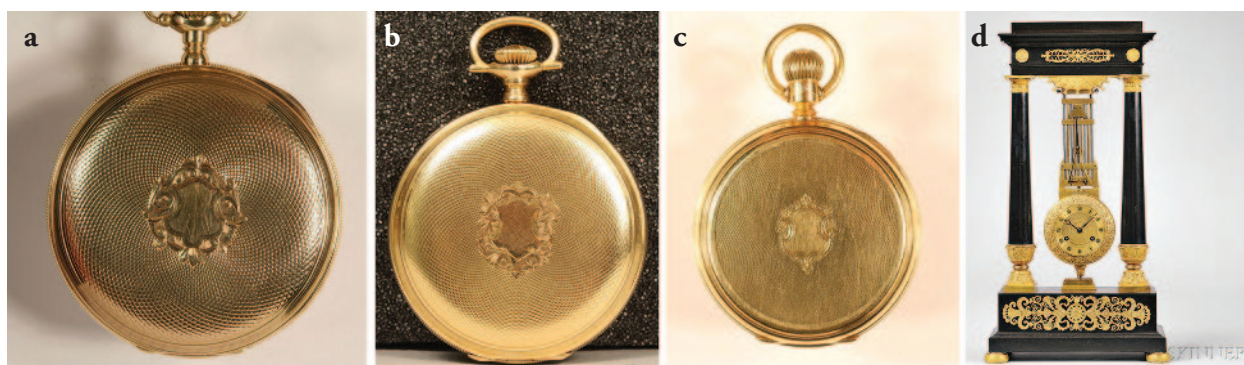


Fig. 9a. Waltham, *Riverside Maximus*, 1911; 9b. Hamilton, *950*, 1940; 9c. American Watch Co., *Model 1872*, 1881; 9d. Unknown, *Ebonized Two-column Inverted Swinging Clock*, 1830 (Courtesy of Skinner)

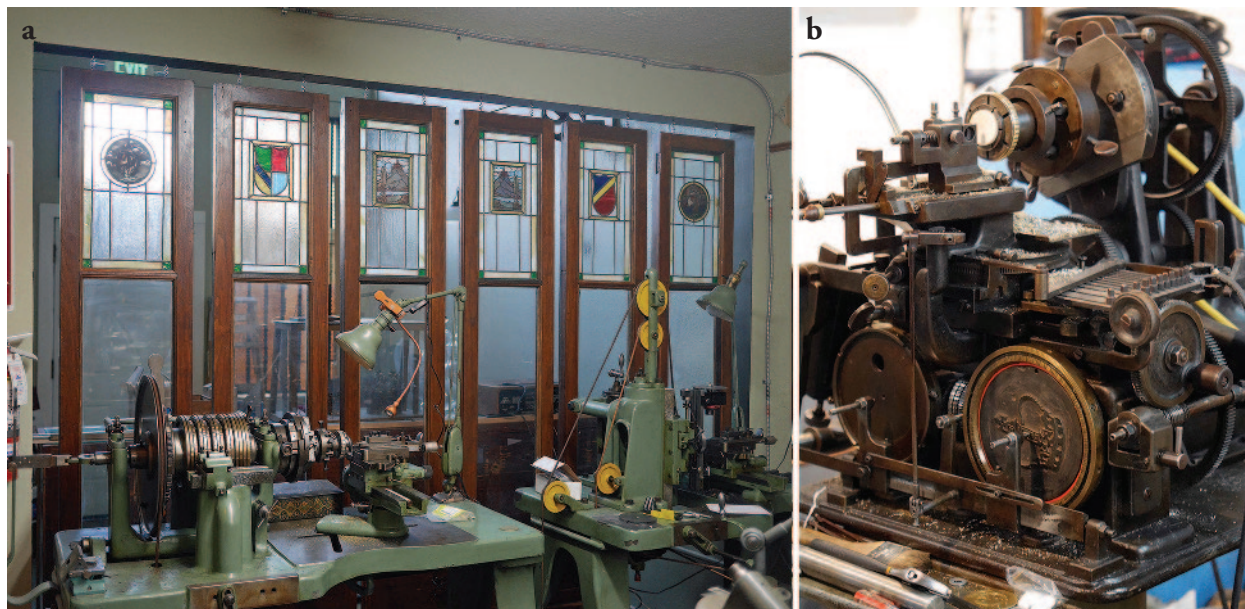


Fig. 10a. Lienhard rose engine (left) and straight-line machine (right); 10b. Brocading machine (Courtesy of Brittany N. Cox)

Sometimes the top layer of metal was cut through to achieve a distinct appearance, as the two metals oxidized differently. Often a method called *chasing* was employed, in which the cutting tip of the tool was dulled so as to impress a shallow line that did not break the surface or remove any metal. Given that engine turned objects were considered fashionable, these developments in fabrication that lowered costs made engine turned objects affordable to the middle class for the first time. Engine turning saw its greatest ubiquity during the American Art Deco period, and its popularity grew well into the 20th century until less expensive techniques and changes in style brought an end to its utility. However, true engine turning and stamped patterns can be found on items ranging from jewelry, money clips, and lighters to mirrors, comb boxes, and makeup cases into the 1970s, although in decreasing numbers (Dicristofaro 2012).

The history of engine turning in America can be traced through machine patents and trade catalogs. In the 19th century, Charles Field was a pioneer and the most prominent manufacturer of engine turning equipment, holding numerous patents on rose engines, brocading machines, watch case dies, and shirt studs. Notably, he is listed on the first American rose engine patent. Despite having enriched the jewelry industry with his innovations, there is but one known mention of his work in a jewelry magazine when he died at age 59. Following his death, Charles Field Jr. took over the business and continued to operate the firm until it

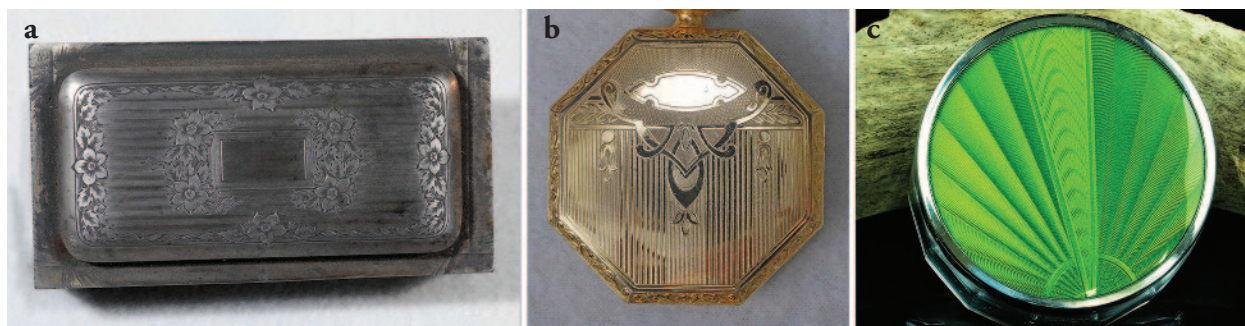


Fig. 11a. Press tool with engine turning (Courtesy of Brittany N. Cox); 11b. Clad metal watchcase with engine turned pressing (Courtesy of Brittany N. Cox); 11c. Celluloid and metal engine turned compact case (Courtesy of Steve White)

closed. He is credited with a patent from 1922 for an engine turning machine capable of decorating multiple pens simultaneously. The firm was not singularly devoted to the making of engine turning equipment, but made other machinery as well and also practiced engine turning for the trade.

By 1910, the F. A. Hall firm began manufacturing a rose engine and straight-line machine similar to those of Charles Field, and in 1920, Linden, another manufacturing firm known for producing textile machines, began fabricating engine turning equipment. Using their background in the design of production machinery, they were successful in developing an efficient production rose engine and straight-line machine; many models were capable of decorating multiple pieces simultaneously. In 1921, the Kenloc firm assumed production of the F. A. Hall straight-line engines, and in 1930, M. J. Brohen from Attleboro, Massachusetts, also entered the market. However, by the end of 1933, the production of American engine turning equipment stopped. During that brief period, the Brohen firm produced both rose and brocade engines.

Despite the decline, engine turning has not completely died out, as it is still practiced by a few devoted shops in Europe, especially around the watch industry, and in the United States. Firms in the United States include the RGM Watch Co. in Mt. Joy, Pennsylvania; Philip Peck, a goldsmith from Huntingdon Valley, Pennsylvania; and Phil Poirier, a goldsmith from Taos, New Mexico. With classes being offered at the Memoria Technica workshop in Seattle and the momentum of a small movement to provide information on the art form, the practice is gradually resurfacing.

3. THE MACHINES

Both the rose engine and straight-line machine are hand operated (figs. 12, 13). When the operator turns the hand crank on the rose engine, the fly wheel rotates, which carries the rosettes and the work piece.

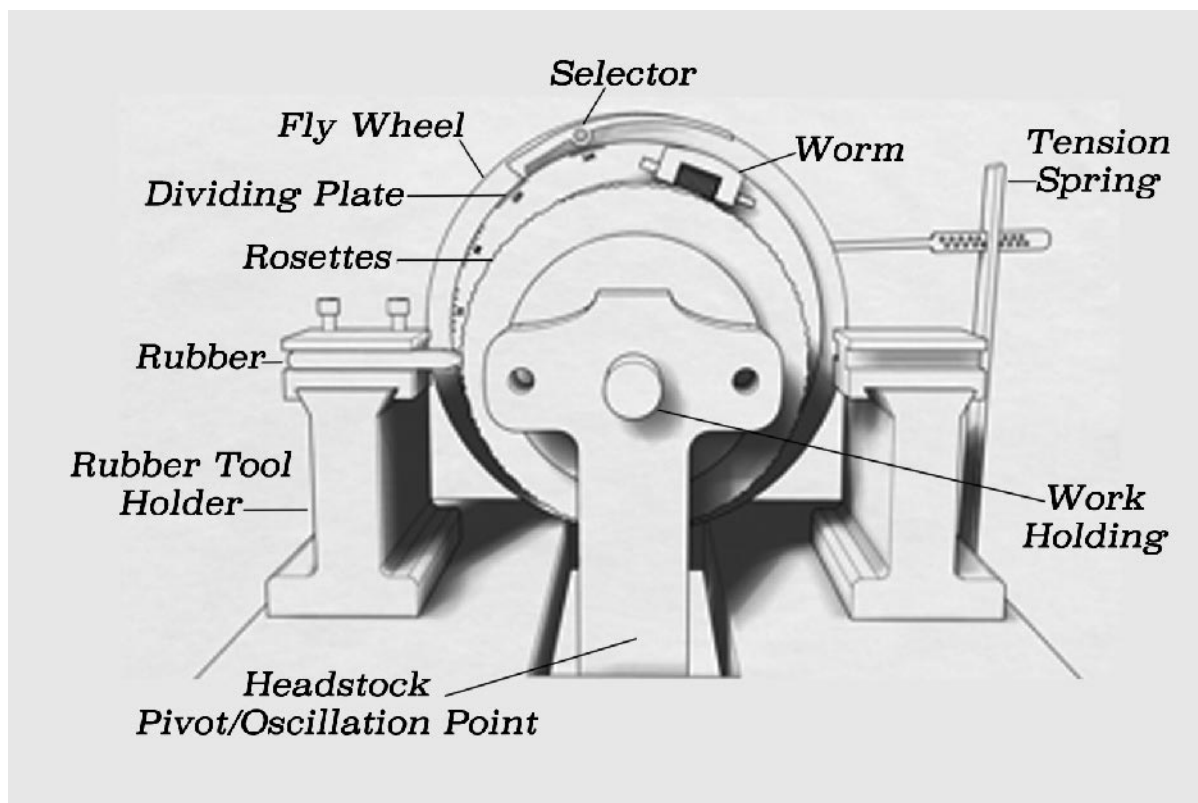


Fig. 12. Diagram of the rose engine (Courtesy of G. Phil Poirier)

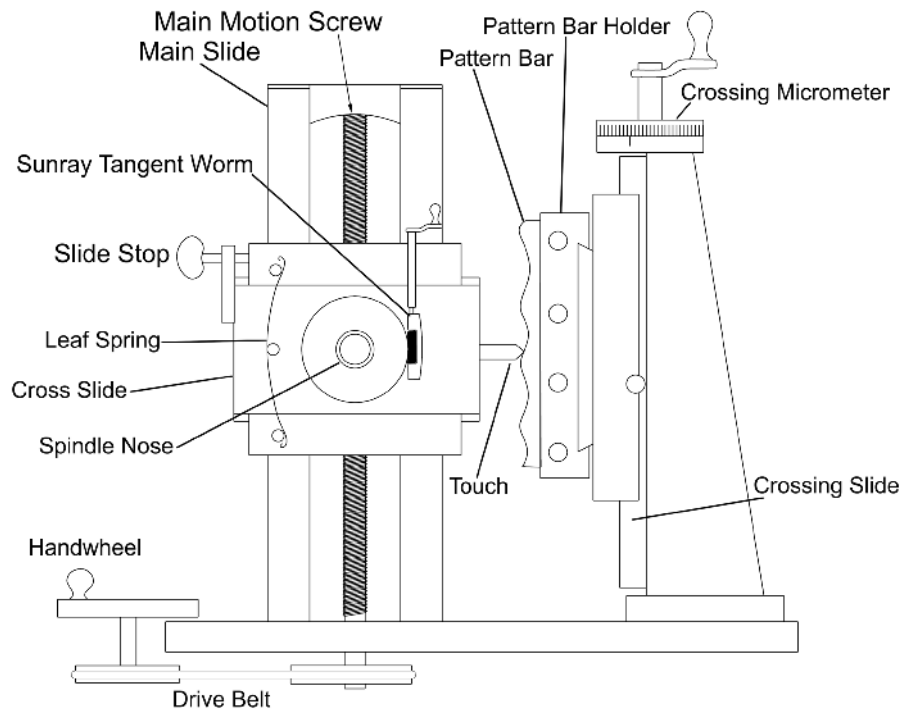


Fig. 13. Diagram of the straight-line machine (Courtesy of G. Phil Porier)

When a rubber is engaged with a rosette, the headstock is forced into oscillation by spring tension against the rubber. The pattern carried by the rosette is then translated to the work surface via a hand-operated stationary cutter that is indexed toward the center as each subsequent cut is made. Similarly, on the straight-line machine, when the operator turns the hand crank, the headstock that carries the work and the rubber is forced via spring tension against a pattern bar. The pattern is placed onto the surface by a hand-operated stationary cutter that can be indexed across the workface or left at a center point. The work piece can then be rotated 360°, creating a radial pattern from the center out.

The invention of the rose engine is certainly earlier than the straight-line machine, although an exact date for the invention of the straight-line machine is unknown.

3.1 ROSE ENGINE

Rose engines, including those made specifically for guilloché work, have not significantly evolved since the 18th century. The machine pictured figure 14 is a 20th century machine made in La Chaux-de-Fonds, Switzerland, by Lienhard, a popular maker of rose and straight-line engines. This was used in the Bulova Watch Co. factory on Long Island, New York, before its closure.

As the spindle rotates carrying the work in the chuck, a “fixed” or nonrotating tool cuts the metal. The depth of cut is set by the “guide” or “geed,” which can be seen on the right side of the cutting tool. It is dressed with an obtuse angle of 160°, as shown in figure 15a.

The depth of the geed can be adjusted to give deeper or shallower cuts. The cutting tool slides forward or back by the hand of the operator and is pushed in until the geed rubs against the work, as shown in figure 15b. An adjustable dead stop can also be used in place of the geed, as seen on the right side of the slide in figure 15b.

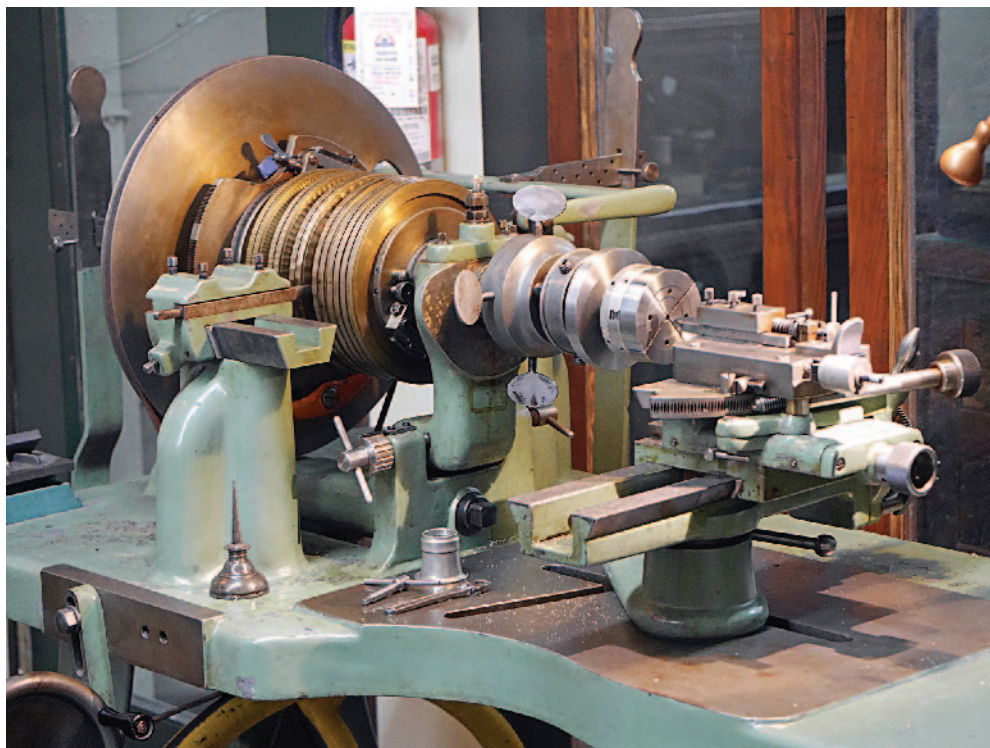


Fig. 14. The rose engine has a headstock that rocks on pivots with a series of cams, called *rosettes*, attached to the spindle and a follower that forces the headstock to rock in accordance to the profile on the rosette (Courtesy of Brittany N. Cox)

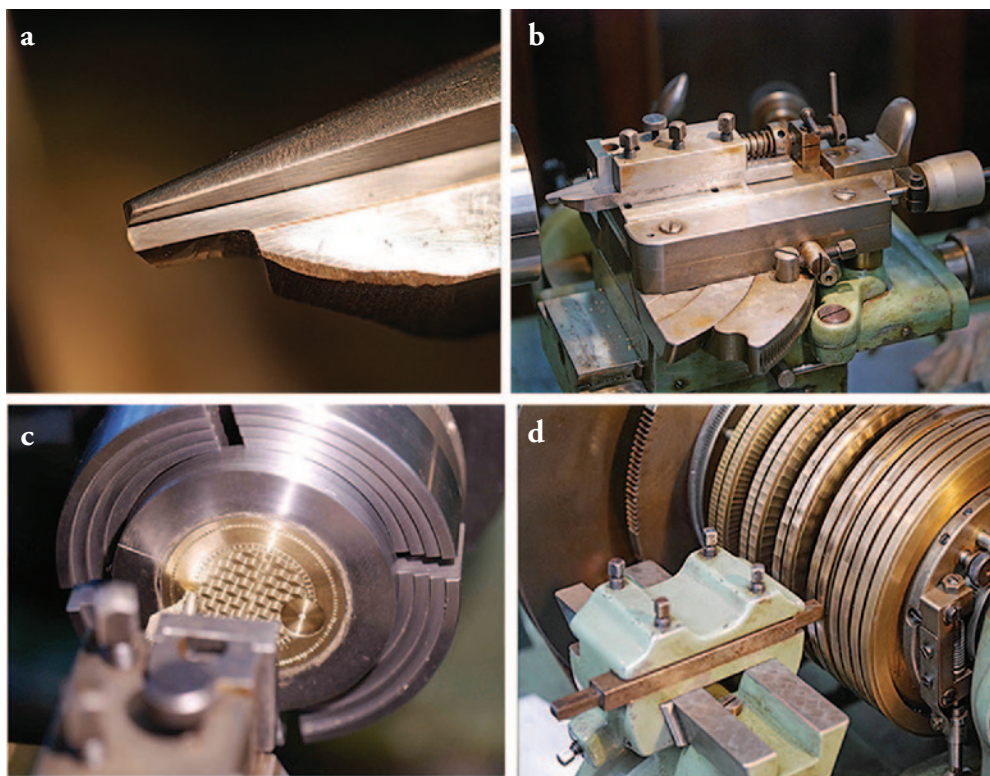


Fig. 15a. The cutting tool and geed; 15b. The slide; 15c. Cutting tool and geed engaged with the work; 15d. Rosette engaged with the rubber (Courtesy of Brittany N. Cox)

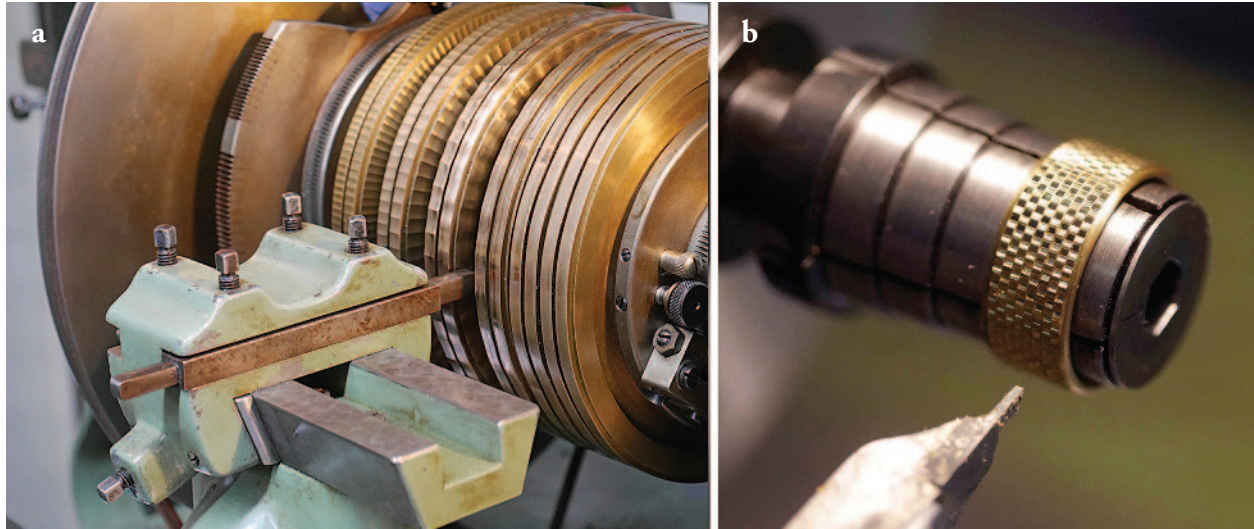


Fig. 16a. Rubber engaged with the rosette; 16b. A ring made using the chisel technique (Courtesy of Brittany N. Cox)

Figure 15c shows both the cutter and geed engaged with the work. The obtuse angle of the cutter ensures that the cut is quite shallow, and the shallow angle, coupled with a slight negative relief on the top of the tool, gives the bright, reflective shine typical of guilloché.

The “rocking” action, produced by the engagement of the rubber with the rosette, is shown in figure 15d. The rosette is basically a cam that carries a pattern or wave but provides only the basis or foundation of a resulting pattern. When combining the wave on the rosette with other aspects of the machine, such as the dividing plate or worm, one can generate several variants from a single rosette. The headstock moves forward and back through spring tension produced by the rubber, also known as a touch, being driven by the outside diameter of the rosette.

A rubber can be seen engaged with the face of the rosette in figure 16a, which causes the spindle to traverse, or slide left and right in the spindle bearings. This action is used for work on the outside of cylinders, such as the ring in figure 16b. It is also used to give what is called the *chisel* effect on watch dials, often to highlight the seconds and chapter rings.



Fig. 17. Rubbers for rose engine (Courtesy of Brittany N. Cox)



Fig. 18a. Crossing plate and detent; 18b. Crossing plate and detent; 18c. A worm and worm wheel
(Courtesy of Brittany N. Cox)

Followers, called *rubbers* or *touches*, some for pumping and some for rocking, can be seen in figure 17. Just as any change of rosette renders a different cut pattern, so does any change to the rubber. A wide variety of rubbers are required for diversified work.

The crossing plate and detent are shown in figures 18a and 18b. This is used to “phase” the pattern on the work. This entails shifting the pattern so that the cuts “cross” over each other, creating optical illusions that are often associated with guilloché. Figure 18c shows a worm and worm wheel, which offer alternative means of phasing. The worm is used for patterns such as the “moiré” and “drape.” The worm offers more minute adjustments as well as greater variability in phasing.

Many distinct patterns can be cut using a single rosette with the same rubber; four such patterns are illustrated in figure 19. These pattern changes were created through alterations in phasing and by moving the tool toward the center in varying amounts between subsequent cuts. Historically, instances of the same pattern have not carried the same name. Different operators of these machines, from region to region and time to time, have used a variety of the names for the same pattern. The popular pattern



Fig. 19. Four distinct patterns cut with the same rosette and rubber on the rose engine (Courtesy of Brittany N. Cox)

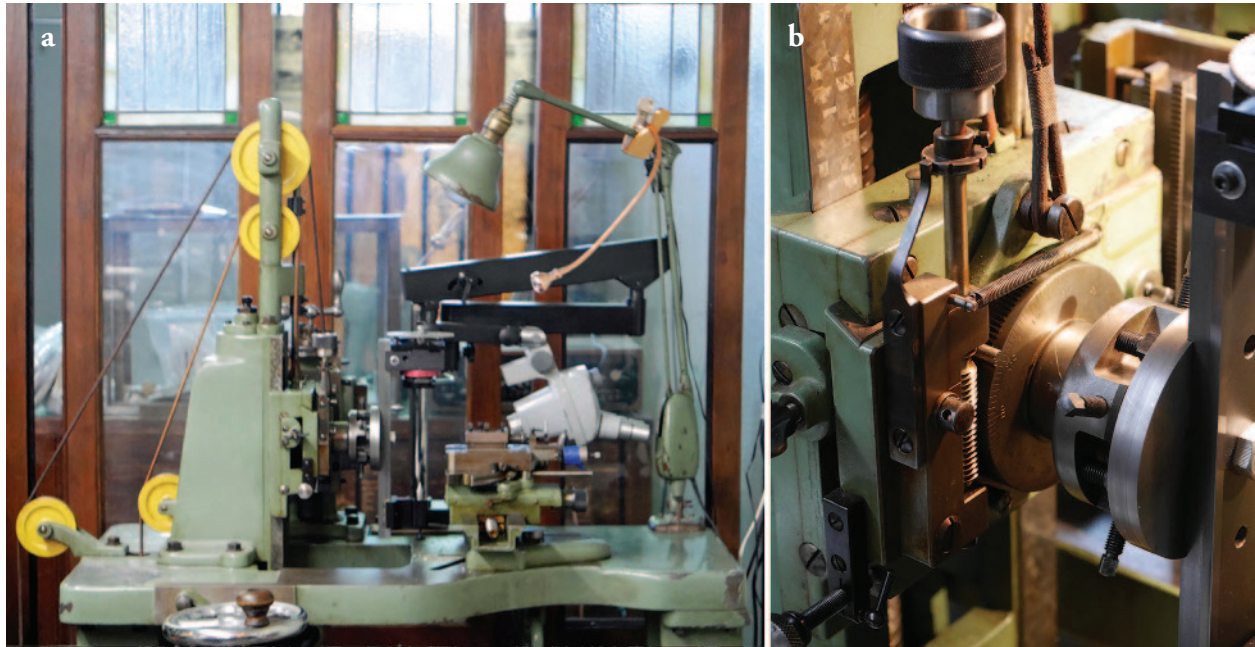


Fig. 20a. Lienhard straight-line machine; 20b. Vertical and horizontal slides (Courtesy of Brittany N. Cox)

known as the *moiré* or the *drape* actually applies to a broad number of patterns that look very similar. Technically, the *moiré* is different from the *drape*, but the untrained eye may not distinguish the two from one another.

3.2 STRAIGHT-LINE MACHINE

A 20th century Lienhard straight-line machine at the Memoria Technica workshop is shown in figure 20a. The leather belts that connect to the spindle go over the top and come down to the left-hand side, carrying weight to counterbalance the weight of the main slides. The headstock is driven by means of a lead screw, which is protected by the large vertical casting on the left-hand side of the machine. The lead screw is moved by means of a belt, which is turned by the crank on the left. The slide rest sits to the right.

There are two main slides, vertical and horizontal, in figure 20b. As the lead screw drives the headstock vertically, the horizontal slide is forced to move forth and back according to the pattern bar being followed by the rubber or touch.

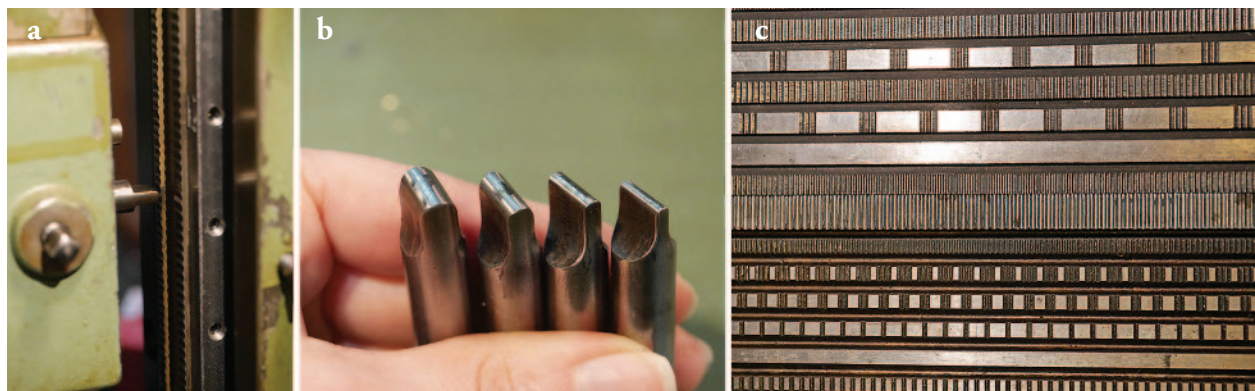


Fig. 21a. Rubber engaged in pattern bar; 21b. A variety of rubbers for pattern bars; 21c. A variety of pattern bars (Courtesy of Brittany N. Cox)

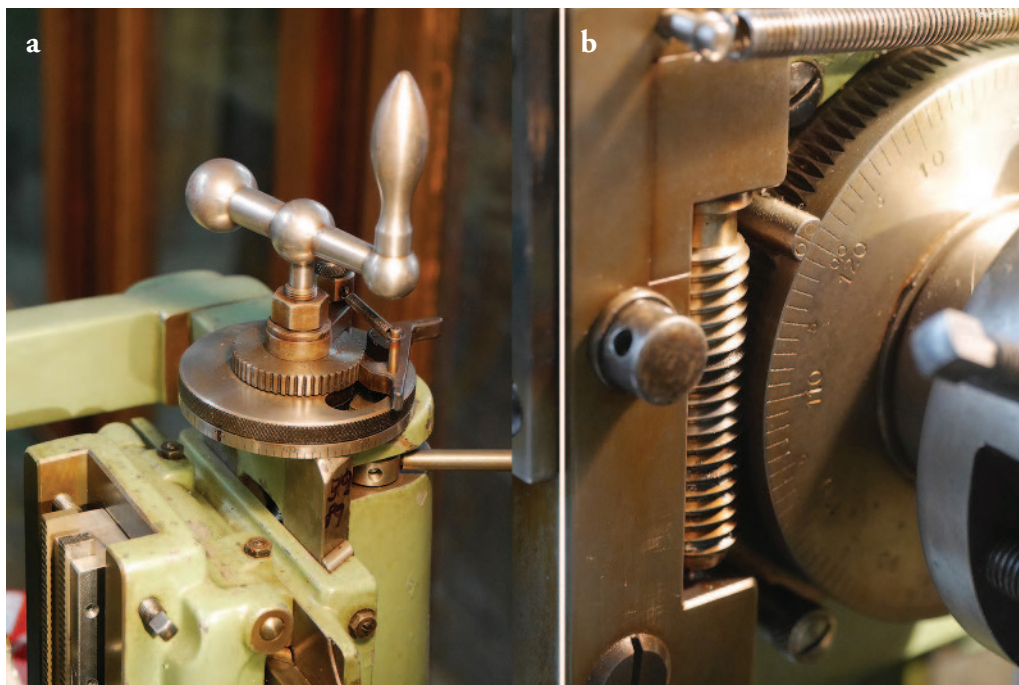


Fig. 22a. The indexing handle and dial, which allows one to change the orientation of the pattern bar between cuts; 22b. The worm and indexing dial for rotating the work between cuts (Courtesy of Brittany N. Cox)

A rubber can be seen engaged with a pattern bar in figure 21a. Figure 21b shows a variety of rubbers, and as with the rose engine, any change to the rubber—even on the same pattern bar—will result in a different cut. Figure 21c shows a variety of pattern bars ranging from low amplitudes to high, allowing a wide variety of work from the same machine.

The pattern bar can be moved with a lead screw, as illustrated in figure 22a. The function of this relates to the “crossing wheel” on the rose engine and is used for “phasing.” It allows the pattern bar to be shifted up and down, changing its relationship to the work. This is what creates the various patterns in straight-line work.

The headstock has an “indexer” that allows the work to be rotated a specific amount (fig. 22b). This mechanism allows for patterns such as a sun burst. The indexing on this machine is done by means of a worm, which rotates the work 3° per revolution. It also serves to augment alignment, especially with work-holding devices such as the pen chuck, which attaches to the headstock spindle. The pen chuck allows cylindrical devices to be held vertically and indexed after each subsequent cut.

4. PATTERNS AND TREATMENT METHODOLOGY

In this section, we provide our catalog of 60 common patterns and discuss our results in treating the 28 metal samples of composition 353 brass, nickel silver, and fine silver. The fresh cut samples have been lacquered to help retain the aesthetic properties of new guilloché work, and we have treated our other samples with commonly encountered treatments so that the degradation of these properties is apparent. We cannot emphasize enough that we are *not* recommending these commonly encountered treatments but are rather discouraging the use of them and giving examples so that conservators can more

easily identify what has been done to objects in the past. We also hope that it will spark some discussion and research into other viable conservation-based treatments that might prove effective in reclaiming original finishes.

Section 4 of this article is continued at <https://mechanicalcurios.com/looking-at-guilloche-in-conservation/>.

ACKNOWLEDGMENTS

The authors would like to thank Tessa Murdoch, G. Phil Porier, Larry and Myra Karp, Robert Cheney, Ken Goldman, Mike Stacey, and Emma Allen for their assistance or contributions to our photographic survey.

REFERENCES

Bainbridge, H. C. 1979. *Peter Carl Fabergé: Goldsmith and jeweler to the Russian Imperial Court*. New York, NY: Crescent Books.

Clinton, C., and G. Daniels. 1965. *Watches*. New York, NY: Viking Press.

Daniels, G. 2002. *Watchmaking*. London, England: Philip Wilson Publishers.

Dicristofaro, P. 2012. History of American engine turning. Paper presented at the Biennial Meeting for the Ornamental Turners International, Scranton, Pennsylvania.

Habsburg-Lothringen, G., and D. P. Curry. 1996. *Fabergé in America*. New York, NY: Thames & Hudson.

Matthews, M. 1984. *Engine turning 1680-1980: The tools & techniques*. England: Author.

Maurice, K. 1985. *Sovereigns as turners: Materials on a machine art by princes*. Translated by D. A. Schade. Zurich, Germany: Verlag Ineichen.

Moxon, J. 1989. *Mechanick exercises: Or, the doctrine of handy-works*. Morristown, NJ: Astragal Press.

Piacenti, K. A. 1989. Ivory towers: The ivories of Coburg. *FMR (Franco Maria Ricci) America International Edition* 42: 69–96.

Reilly, R. 1989. *Wedgwood*, vol. 1. New York, NY: Stockton Press.

Syndram, D. 2004. *Renaissance and Baroque treasury art: The Green Vault in Dresden*. Translated by D. Kletke. Dresden, Germany: Die Deutsche Bibliothek.

Syndram, D., and A. Scherner, eds. 2004. *Princely splendor: The Dresden Court 1580-1620*. Milan, Italy: Electa.

FURTHER READING

Edwards, J. F., ed. 2013. *Holtzapffel volume VI: A compendium of rare or previously unpublished material related to the art & craft of ornamental turning*. Tonbridge, UK: John Edwards.

Forbes, C., J. G. Hohenzollern, and I. A. Rodimtseva. 1989. *Fabergé: The Imperial Eggs*. Munich, Germany: Prestel.

Holtzapffel, J. J. 1973. *Principles and practice of ornamental or complex turning*. New York, NY: Dover.

Porier, G. P. 2015. "Art, History and Processes of Guilloché Engraving." *The Santa Fe Symposium*. <http://www.santafesymposium.org/2015-santa-fe-symposium-papers/2015-art-history-and-processes-of-guilloche-engraving>.

Porier, G. P. 2016. "The Parts and Processes of a Rose Engine in the Modern Shop." *The Santa Fe Symposium*. <http://www.santafesymposium.org/2016-santa-fe-symposium-papers/2016-the-parts-and-processes-of-a-rose-engine-in-the-modern-shop>.

Shevlin, C. 2017. *Guilloché: A history & practical manual*. Atglen, PA: Schiffer Publishing Ltd.

Tweddle, N. 1950. *The rose engine lathe: Its history development and modern use*. UK: Society of Ornamental Turners.

Zapata, J., A. von Zadora-Gerlof, and D. Behl. 1999. *The art of Zadora: America's Fabergé*. New York, NY: Vendome Press.

SOURCES OF MATERIALS

Fine silver

Rio Grande
7500 Bluewater Rd. NW
Albuquerque, NM 87121
505-839-3000
<https://www.riogrande.com>

353 brass, Nickel silver

McMurray Metals Co.
3000 Elm St.
Dallas, TX 75226
214-742-5654
<http://mcmurraymetals.com>

BRITTANY NICOLE COX is a horological conservator and earned her MA in Conservation Studies from the University of Sussex, specializing in clocks and related dynamic objects in partnership with West Dean College in the United Kingdom. Also trained as a jeweler and a certified

watch and clockmaker, she operates Memoria Technica, an independent workshop in Seattle, Washington. She specializes in the conservation of antique complicated clocks, watches, automata, mechanical music objects, and mechanical magic. Her research interests include illuminating the lost techniques of ornamental turners of the 17th century, scratch abrasive holography as related to the rose engine, materials and adhesives for bellows in singing bird boxes, and developing new conservation techniques for working with automata. Address: 1122 East Pike St., #632, Seattle, WA 98122. E-mail: bcox@mechanicalcurios.com

DAVID LINDOW is an independent clockmaker who owns and operates Lindow Machine Works, located in Lake Ariel, Pennsylvania. He specializes in restoring period Americana clock movements and other instruments, as well as building handmade movements. After the acquisition and subsequent restoration of an antique rose engine lathe, he expanded his business to include the manufacture of new rose engines. Since the introduction of his lathe in 2006, David has not only restored numerous pieces of vintage engine turning equipment but has also worked to develop new tooling and accessories. His research interests include identifying works by American clockmakers and unusual complications in clock mechanisms. He also works to catalog antique engine turning equipment. Address: 527 Gravity Rd., Lake Ariel, PA 18436. E-mail: david@lindowmachineworks.com