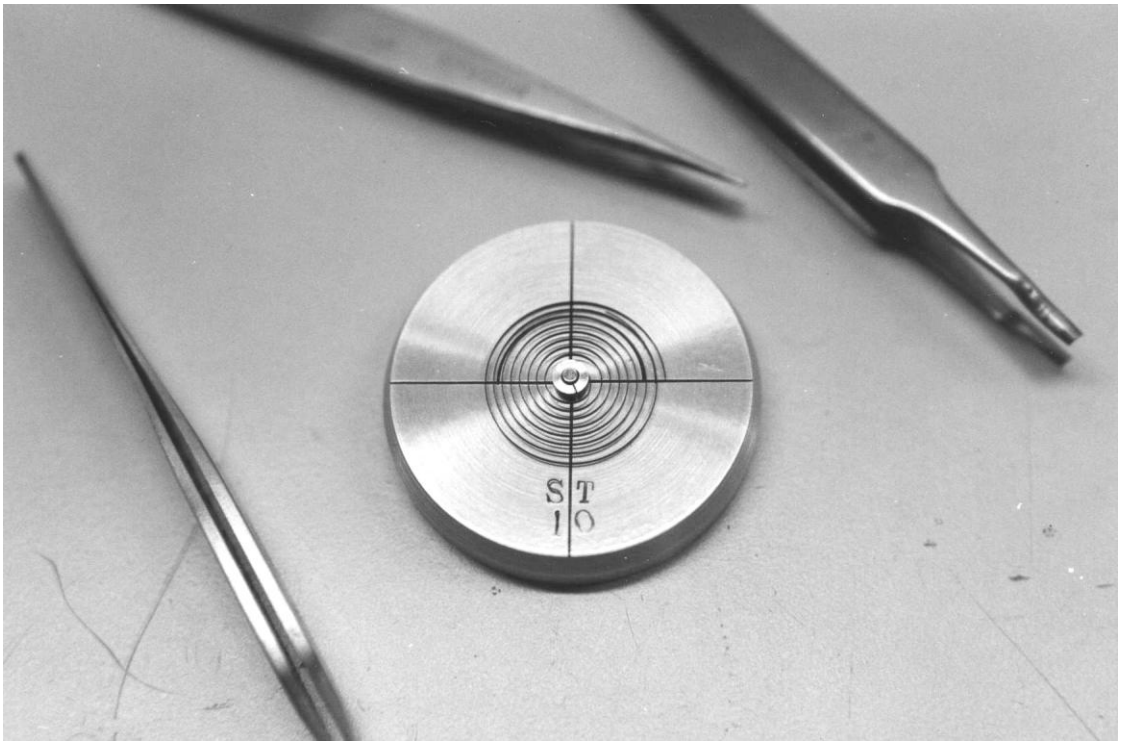
Newsletter of the Horological Tool Chapter #173 of the NAWCC

Tool Enthusiasts' Round-Up

In This Issue: Inside a Hairspring Maker's Workshop

Upcoming Chapter Activities and Classified Ads



Special Tools Used to Form and Collet a Hairspring

Spring 2011

No. 8

The Horological Tool Chapter of NAWCC

The Tool Enthusiasts' Round-Up is the newsletter of the Horological Tool Chapter #173 of the National Association of Watch and Clock Collectors Inc., a non-profit educational organization.

The annual chapter dues of $10 will ensure that members receive the newsletter and are included in the Membership Directory when it is published. Members are also entitled to one classified ad in each issue. If you are interested in joining this chapter, which will meet at various large regionals and also at the National Convention each year, please send your annual dues to the Chapter Secretary/Treasurer.

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Wanted
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Derbyshire Elect model lathe attachments- pivot polisher, screw cutting attachment, roller file rest, and screw feed tailstock - will trade - for sale: tools from the Elgin watch factory, lathes, grinders, millers, etc…some made by American Watch Tool. J. Dill, 2117 22nd St. Road, Greeley, Co. 80634, Tel: 970-353-8561.

For Sale
NOW AVAILABLE ONCE AGAIN "THE WATCHMAKERS STAKING TOOL" BY PERKINS & LUCCINA, $35.00 Postpaid, send remittance to, Ronald G. Bechler, 726 Royal Glen Drive, San Jose, CA 95133-1446, (408) 926-3212

American Watch Tool lathe, length of bed 28", swing is 7", Includes compound slide and one 3WO Hardinge collet. Chuck in tailstock not included. $450. Deena Mack, 644 Geise Rd. Attica, NY 14011, 585-591-1343, email dmack18@rochester.rr.com.

A hairspring vibrating tool, circa 1960.

Inside a Hairspring Maker's Workshop

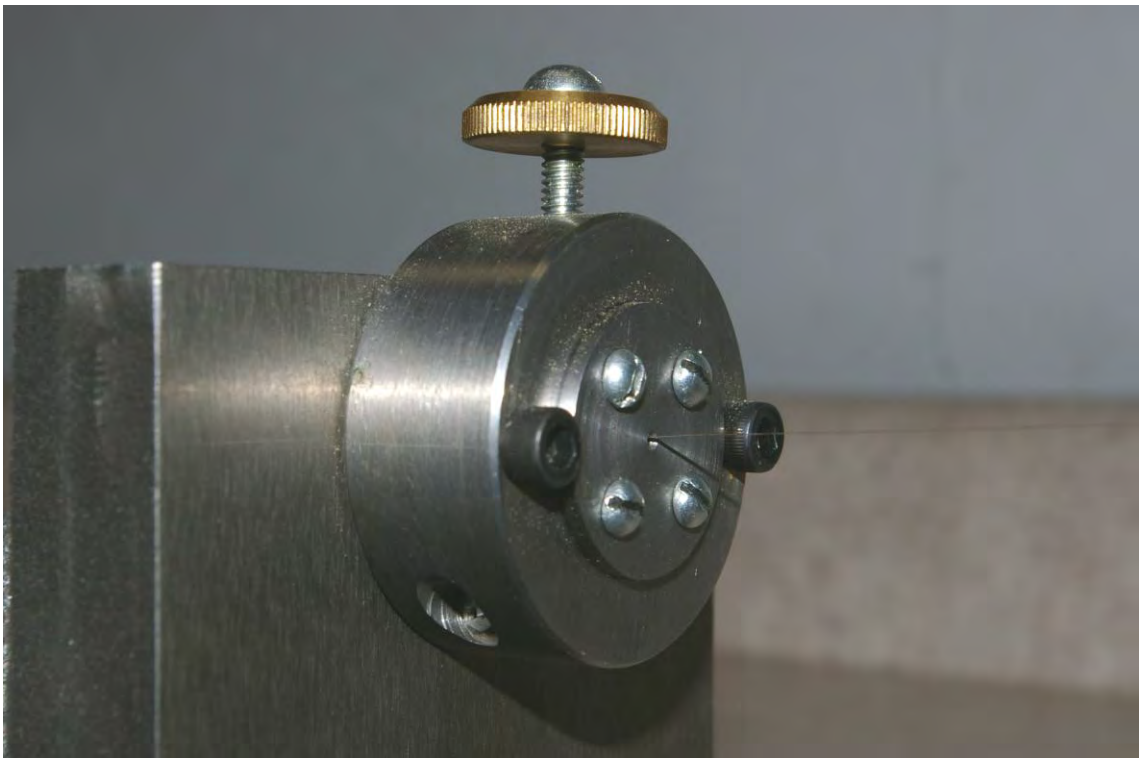


Figure 1. A wire drawing die is used to make hairspring wire.

The history of the hairspring dates to the fifteenth century when Robert Hooke (1635-1703) discovered the engineering law of elasticity. "Hooks Law" as it has became known, states that the stretching of a solid body is proportional to the force applied. The horologist will recognize that this is the governing principle behind the hairspring used in many clocks and watches.

Who first applied this engineering principle to horology has been a matter of some discussion but by 1675, Huyghens of London, constructed a timekeeper utilizing this principle. In its development many materials have been used to manufacture hairsprings. These range from pig bristles to springs made of glass and solid gold. Steel became the most popular material because it was relatively inexpensive and could be easily formed. This standard was in use for more than two hundred years until more exotic alloys were introduced that had several advantages.

The Palladium alloy hairspring was invented in 1877 by Charles Paillard. These springs did not rust and remained unaffected by magnetism. Further developments produced alloys that had neutral temperature coefficients of expansion. This breakthrough meant that the complex

balance wheel designs necessary to compensate for temperature changes, could be eliminated. This advantage made steel hairsprings obsolete and their manufacture on a large commercial scale ceased many years ago.

The author reinvented the process when he found himself unable to obtain hairsprings for the many clocks he repaired. The original process was actually separated into three different trades: the wire maker, the hairspring maker, and the springer who vibrated and fitted the spring to the clock or watch balance.

The process of making a hairspring begins by drawing round steel wire through a series of dies to reduce it to the approximate size, Figure 1. It is then flattened from a round profile to a rectangular cross-section using a rolling mill. This flattening process is followed by a second wire drawing using diamond dies to produce an extremely accurate wire dimension. It is important that the wire be annealed after each step in order to make it malleable and to prevent stress cracking.

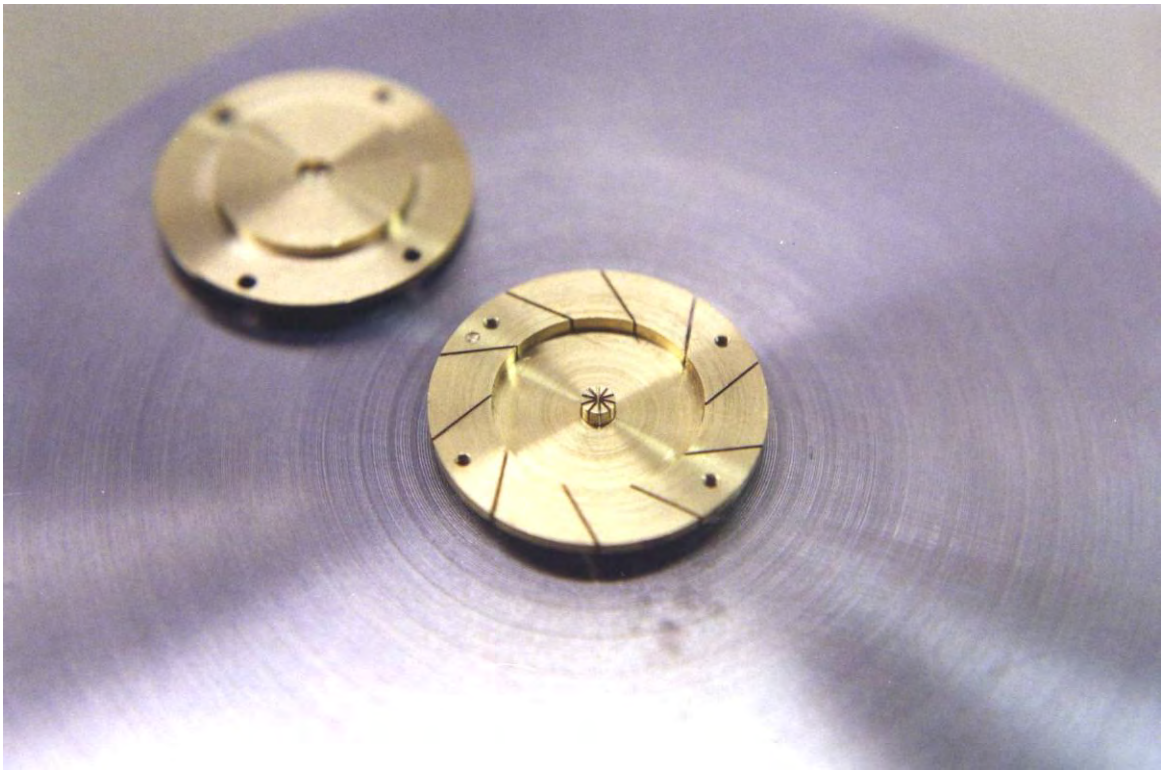


Figure 2. The hairspring mold and cover.

A mold is then machined from brass based on the overall diameter of the needed spring and the number of wires to be wound, Figure 2. The spacing of the hairspring coils is ultimately governed by the number of wires used and the thickness of each wire. For watch hairsprings, 3 to 4 wires are normally used but for a clock hairspring the number can be 7 or more.

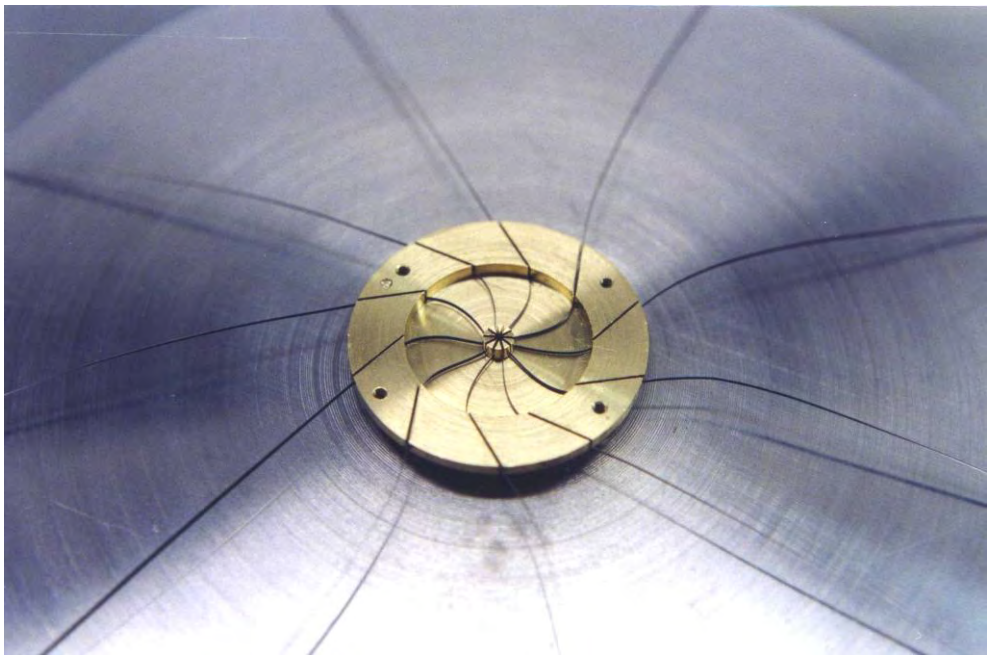


Figure 3. Wires placed in the mold and attached to a center winding arbor.

After the mold is made, the wires are placed into the mold and attached to a center winding arbor, Figure 3. A cover is then attached to the mold and the arbor is rotated. This winds the hairspring wire into the mold, much like one winds a mainspring in a clock or watch barrel, Figure 4.

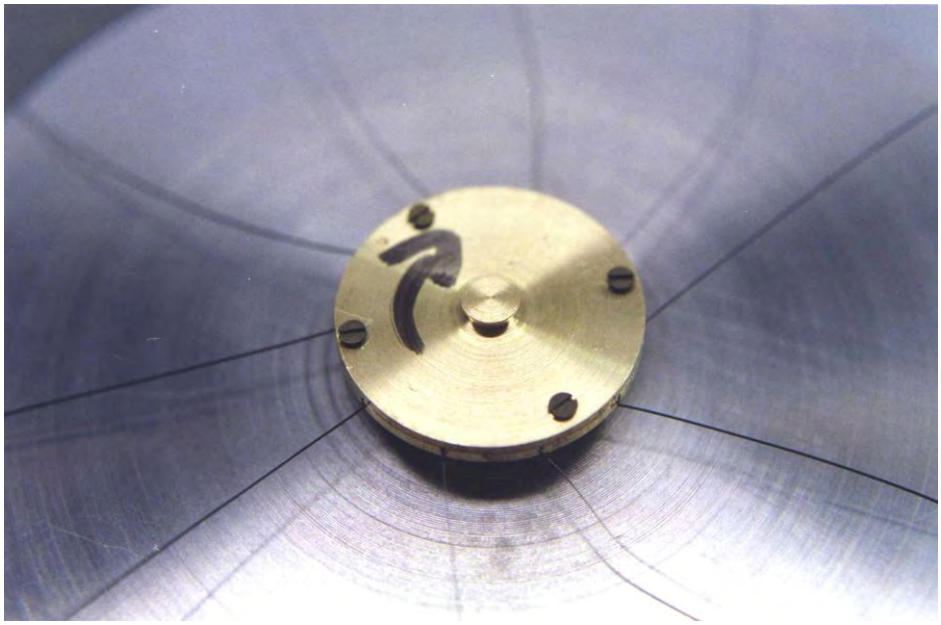


Figure 4. Winding the hairspring wire into the mold.

If only a small number of molds are to be wound, than the arbor is turned by hand like some of the simple watch mainspring winders operate. However, if production is required, the arbor is mounted into a winding stool that uses a hand crank to quicken the process, Figure 5.

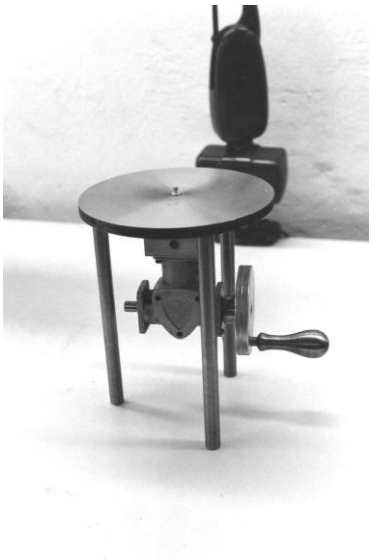


Figure 5. A winding stool.

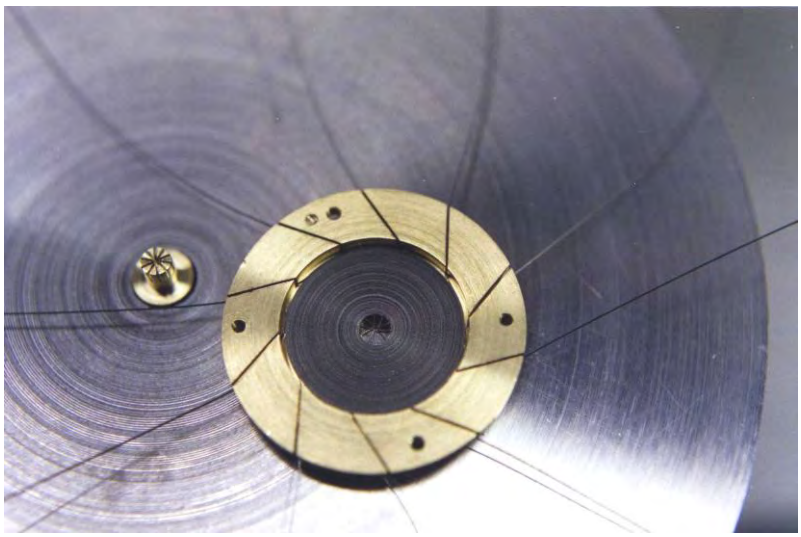


Figure 6. The spring after winding.

After winding is complete, the arbor and cover are removed to inspect the spring, Figure 6. If properly wound, the cover is replaced and the mold is placed into a furnace for heat treating. After hardening and tempering the spring is carefully removed from the mold, Figure 7. Because of the high temperatures required for hardening, the molds have a limited life and must be remade frequently.

Figure 7. The hardened and tempered hairsprings.

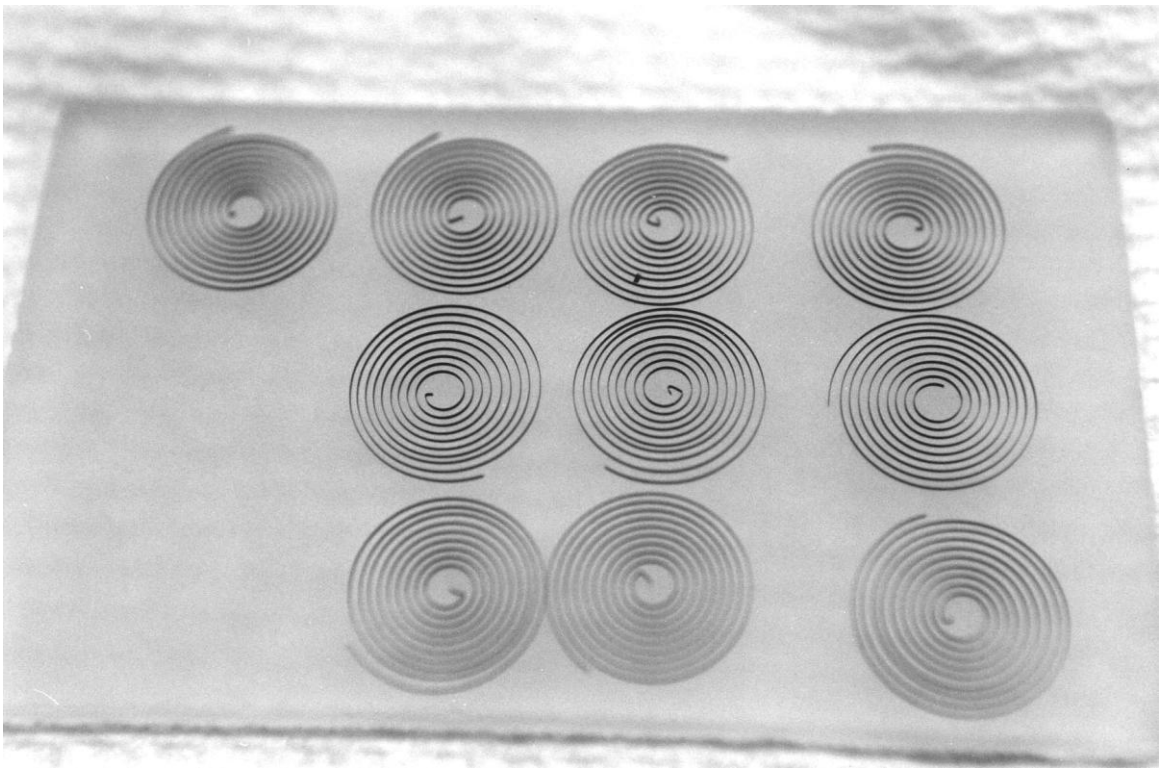


Figure 8. The hairsprings after separation.

The hairsprings are carefully separated and placed on a flat plate for inspection, Figure 8. They are then cleaned and carefully blued. Blueing is done by using a hairspring blueing tool as shown in Figure 9. This tool holds the spring between a brass plate and clamping arm. A flame is then used to heat the bottom of the tool until the spring turns blue. The spring is then quenched in oil.

Figure 9. A hairspring blueing tool.

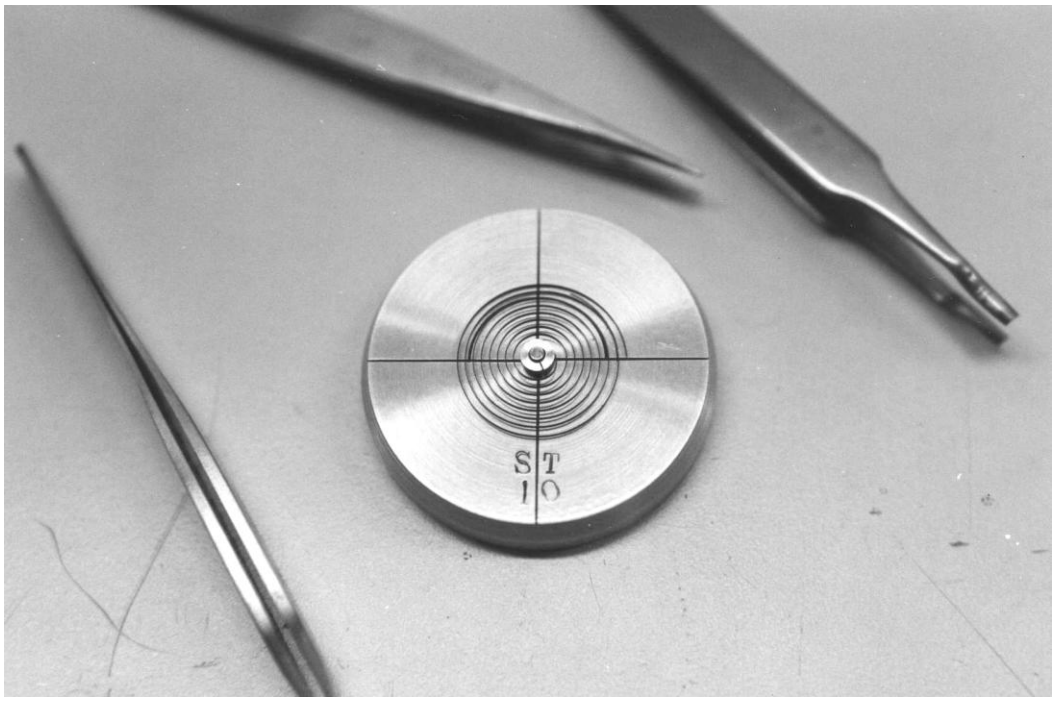


Figure 10. Colleted the hairspring using special tweezers.

The spring is then colleted and given its final shape, Figure 10. It is then placed into a torque gauge for testing. Several forms of this gauge are known. The best known gauge was invented by Mr. Bottom and is known as the Bottom Hairspring Gauge. The hairspring collet is mounted onto a center post. The stud end is held by a traveling arm. When rotated, it winds the hairspring up and this torque is measured against a master spring in the base.

The differential torque is displayed on the gauge dial by the defection of needle, Figure 11. This gauge was made by the author and won first place in the NAWCC Horological Craft Contest, in 2006.

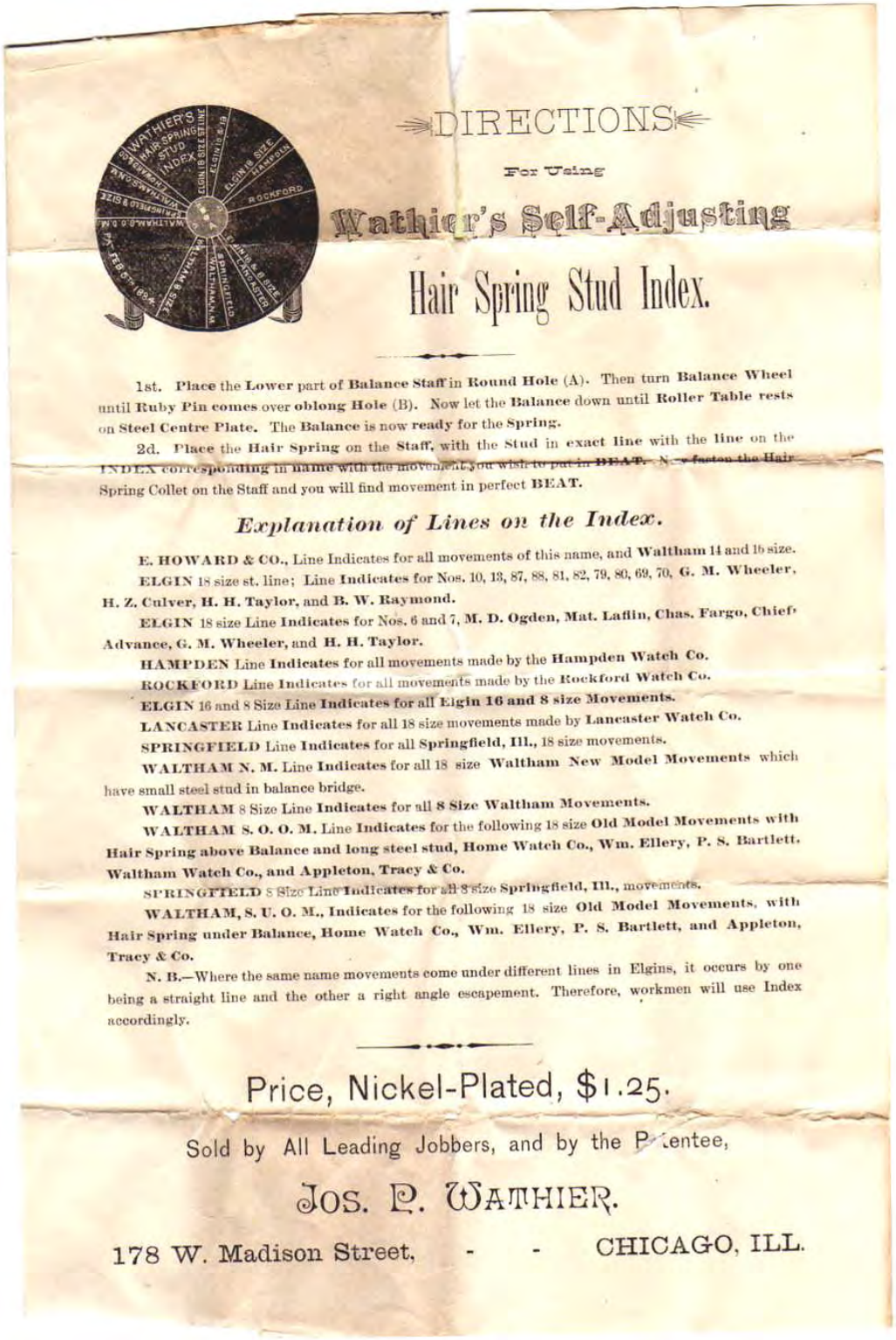
Figure 11. A Bottom style hairspring gauge.

Once the hairspring has been tested to the correct torque it is packaged for delivery to the customer. The terminal coil is then formed and fitted to the regulator by the horologist.

Although the process of making a hairspring appears to be rather simple, a high degree of skill is needed to get repeatable results. This takes hours of practice and like hairspring vibrating, it is something not easily learned in a short period of time.

Bruce Forman

More Hairspring Tools



DIRECTIONS

For Using

Wathier's Self-Adjusting

Hair Spring Stud Index.

1st. **Place** the **Lower** part of **Balance Staff** in **Round Hole** (A). Then turn **Balance Wheel** until **Ruby Pin comes** over **oblong Hole** (B). Now let the **Balance** down until **Roller Table rests** on **Steel Centre Plate.** The **Balance** is now **ready** for the **Spring.**

2d. **Place** the **Hair Spring** on the **Staff,** with the **Stud** in **exact line** with the **line** on the **INDEX corresponding in name** with the movement you wish to put in **BEAT.** Now fasten the Hair Spring Collet on the Staff and you will find movement in perfect **BEAT.**

Explanation of Lines on the Index.

E. HOWARD & CO., Line Indicates for all movements of this name, and **Waltham** 14 and 16 size.

ELGIN 18 size st. line; Line **Indicates** for Nos. 10, 13, 87, 88, 81, 82, 79, 80, 69, 70, **G. M. Wheeler, H. Z. Culver, H. H. Taylor,** and **B. W. Raymond.**

ELGIN 18 size Line **Indicates** for Nos. 6 and 7, **M. D. Ogden, Mat. Laflin, Chas. Fargo, Chief Advance, G. M. Wheeler,** and **H. H. Taylor.**

HAMPDEN Line **Indicates** for all movements made by the **Hampden Watch Co.**

ROCKFORD Line Indicates for all movements made by the **Rockford Watch Co.**

ELGIN 16 and 8 Size Line **Indicates for all Elgin 16 and 8 size Movements.**

LANCASTER Line **Indicates** for all 18 size movements made by **Lancaster Watch Co.**

SPRINGFIELD Line **Indicates** for all **Springfield, Ill.,** 18 size movements.

WALTHAM N. M. Line **Indicates** for all 18 size **Waltham New Model Movements** which have small steel stud in balance bridge.

WALTHAM 8 Size Line **Indicates** for all **8 Size Waltham Movements.**

WALTHAM S. O. O. M. Line **Indicates** for the following 18 size **Old Model Movements with Hair Spring above Balance and long steel stud, Home Watch Co., Wm. Ellery, P. S. Bartlett, Waltham Watch Co., and Appleton, Tracy & Co.**

SPRINGFIELD 8 Size Line **Indicates** for all 8 size **Springfield, Ill.,** movements.

WALTHAM, S. U. O. M., Indicates for the following 18 size **Old Model Movements, with Hair Spring under Balance, Home Watch Co., Wm. Ellery, P. S. Bartlett, and Appleton, Tracy & Co.**

N. B.—Where the same name movements come under different lines in Elgins, it occurs by one being a straight line and the other a right angle escapement. Therefore, workmen will use Index accordingly.

Price, Nickel-Plated, $1.25.

Sold by All Leading Jobbers, and by the Patentee,

JOS. P. WATHIER.

178 W. Madison Street, - - CHICAGO, ILL.

Original Instructions for a Hairspring Stud Index

A hairspring stud index in the original box with instructions. Not many have survived in this condition. We reprinted the instructions (previous page) for those who may own one but never knew how to use it!

A simple hairspring torque gauge. Similar in principle to the Bottom hairspring gauge but the stud end of the hairspring is held with a pair of tweezers and the table is turned to apply torque. The end of the shaft that originally held the hairspring to be tested (above the balance cock) is broken off. The master hairspring is still intact. The author has seen two gauges like this. Did a watch factory make them…. does anyone know?

A Manross Hairspring Tester (model A) circa 1960? This tool is said to have been used in a New England factory that made aviation instruments. It is very similar in design to the Bottom hairspring gauge.

If you have an interesting hairspring tool you would like to share with our membership, please mail the editor a photograph and description for the next Reader's Feedback.