A balance vibrating tool – 9

by Guy Gibbons

The balance spring stud

Many designs of stud can be found in spring-balance clocks and watches, and all make use of a D-shaped taper pin to secure the end of the balance spring in a circular hole. But when it comes to the location of the stud in the frame or cock the designs vary considerably, and can perhaps be categorised under three headings:

- a circular, friction-fit peg with neither vertical nor rotational constraint. Commonly found in wrist watches where space is at a premium and cylinder platform escapements. Some variants may be shouldered to offer axial restraint.
- a triangular peg or a circular peg with a V-groove planed in it and given vertical and circular restraint by a set-screw tightened onto the flat side (triangular) or into the V-groove. Perhaps the most common type today, and found in many lever escapements
- an angular stud located by an adjacent flat face and secured by a screw. Generally found in chronometers with helical balance springs and occasionally other free-sprung escapements. No vertical adjustment is possible.

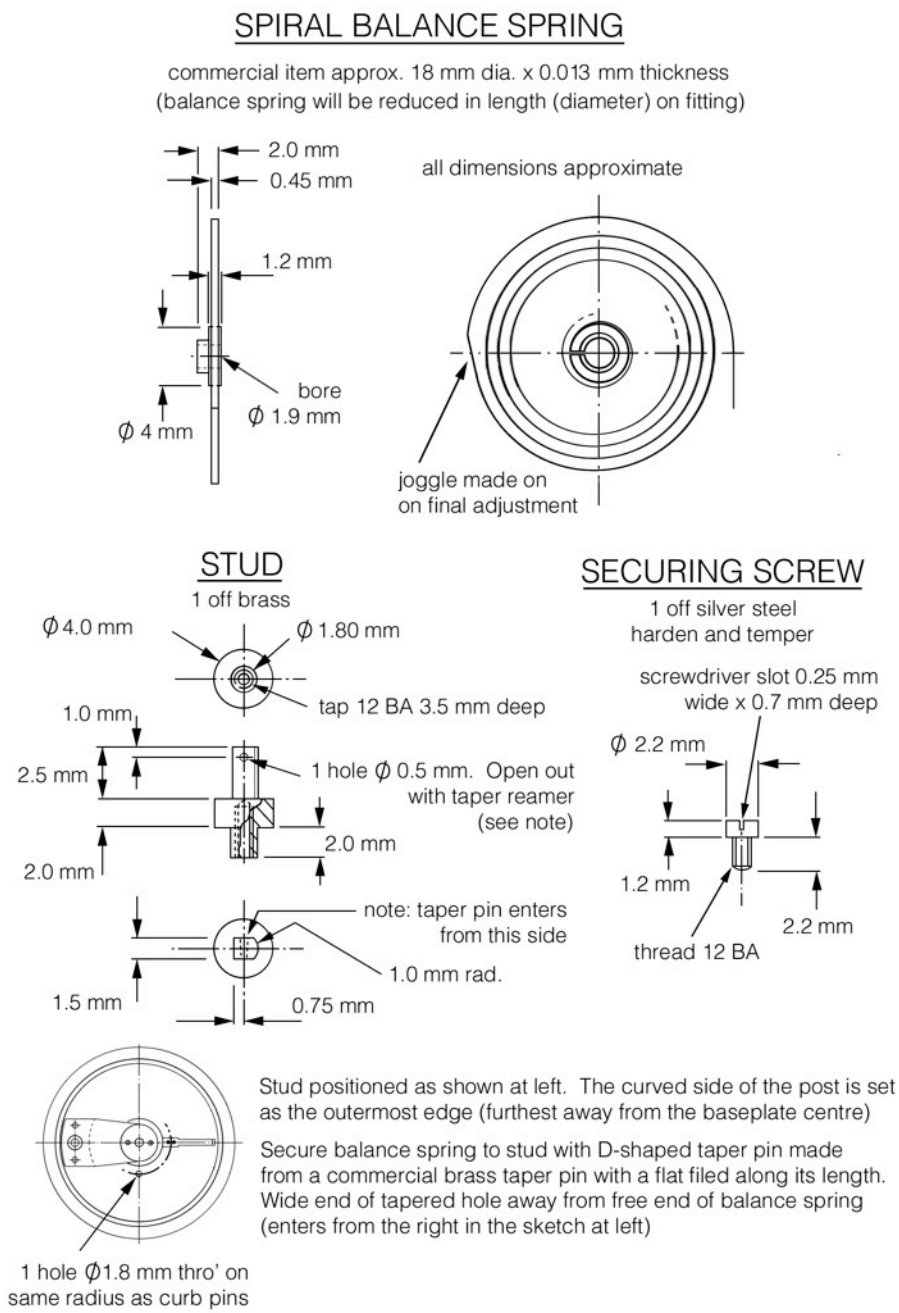
The first type is very neat and might seem the easiest to make but in reality obtaining a perfect friction-fit is not easy, and the fit will suffer if the stud is removed several times during final assembly. Best suited to batch production with a standardised balance and balance spring where the initial fit of the balance spring can be sure to be correct.

The second type is equally neat and is an excellent solution, ensuring that the stud goes back in its correct circular position every time it is fitted, with vertical adjustment to ensure the balance spring lies truly flat. But for our vibrating tool there are two big difficulties; there is no easy location for the set-screw, and making a wobble-free peg and triangular hole in the baseplate or cutting a longitudinal V-groove in the peg requires considerable skill.

For the vibrating tool, an easy location for the set-screw might be created by rivetting a 5 mm dia. boss standing proud of the upper surface by 2.2 mm high, which could be tapped to take a set-screw. But the problem of cutting the V-groove remains.

The third type is less neat but entirely possible, especially if two screws (or one screw and a steady pin) are used to secure the stud to the baseplate in the absence of an adjacent flat locating surface.

With all these issues to consider, the simplest design is perhaps a simple post as shown in the drawing. As it offers no vertical adjustment, getting the balance spring flat when in position requires the balance spring to be adjusted axially (vertically) on the balance staff. It is this method that we will describe.



The balance spring

The balance spring is not an easy item to make and few horologists will ever attempt it, so we will be using commercial balance springs.

Materials required

- balance spring. Clock balance springs are available from most material dealers in assortment boxes of 72
- short length (50 mm) of 4 mm dia. brass rod
- selection of small brass taper pins.

Design and drawings

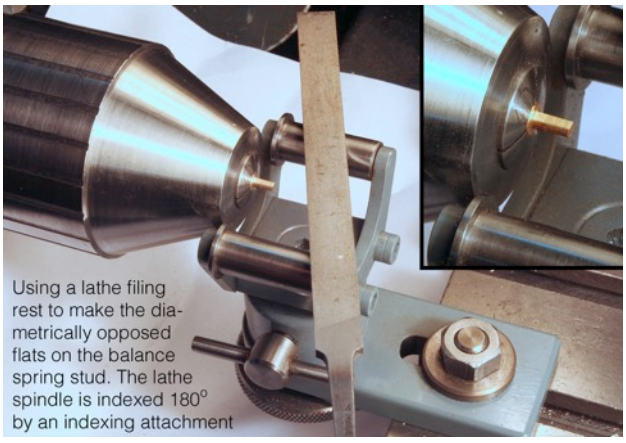
Comment has been made on the design of the stud; if you feel up to the challenge, by all means pursue one of the other options.

The most suitable balance spring from the selection is the largest diameter spring with a stepped centre collet. The balance staff on which it fits has no axial location shoulder so that the balance spring can be adjusted to ensure it 'breathes' truly when oscillating (i.e. there is no wobble).

Making the stud

Take a length of 4 mm dia. brass rod and drill and tap the end 12 BA, finishing with a plug or bottoming tap. Now turn the peg to 1.8 mm dia., making sure you very slightly undercut the base so it bears on the baseplate at its outer 4 mm diameter. As the base is larger in diameter than the underside of the securing screw head (4 mm cf. 2.2 mm dia.), this will help prevent the stud from turning when the screw is tightened from beneath.

Cut off and reverse in the collet, and turn and file the stud post to the dimensions show. A lathe filing rest helps to get the three flats at right angles and of the same depth opposite and central. The two opposing flats could be omitted, but not only do they make drilling the cross hole for the balance spring easier but also proved something to grip when bringing the stud to its correct alignment when tightening to the baseplate. The third flat should not be omitted as this provides clearance for the balance spring coil one in from the outer coil.

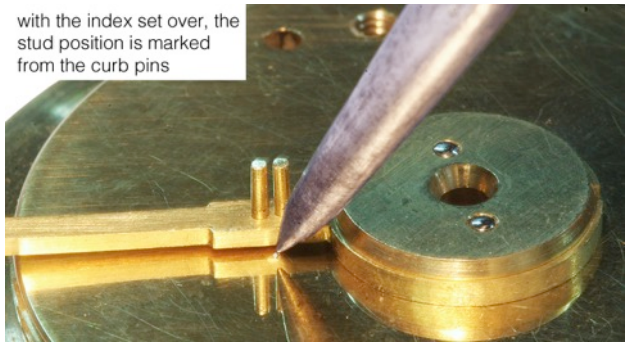


Using a lathe filing rest to make the diametrically opposed flats on the balance spring stud. The lathe spindle is indexed 180° by an indexing attachment

The cross hole is drilled 0.5 mm dia. and opened out gently from one side with a broach. Make sure you broach with the point in the direction towards the end of the balance spring so the clearance flat is on the inside. Once the taper broach is cutting for the full length of the hole, stop and lightly deburr the open ends. Prepare a brass taper pin by filing one side flat to give a D-shape and try to fit it into the hole alongside the balance spring. Adjust the taper pin (you may need to make several to get a good fit) and/or the hole until the balance spring is nicely held. On final fitting the taper pin should protrude about 1 mm each side.

Finally make the 12 BA cheesehead screw, making sure that the underside of the cheesehead is smooth and the corner very slightly radiused so that it (rather than the stud) will rotate when tightened. Also make sure it is does not bottom in the threaded hole; if it does you must cut the threaded hole deeper or shorten the screw. Finish by hardening, tempering and polishing.

The stud must be fitted so that its centre is at the same radius as the gap between the curb pins from the centre of the balance staff. If it is not, the symmetry with which the balance spring expands and contracts ('breathes') as the balance oscillates will be uneven. Fit the index to the baseplate and mark the stud position from the centre of the curb pins, and drill slightly small. Now very carefully broach the hole in the baseplate so that the spigot on the stud is a good fit, making sure the peg is slightly short of the end of the hole in the baseplate. Fit the screw to check it tightens properly.

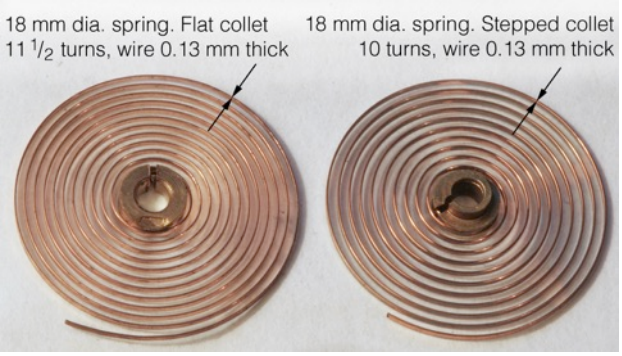


with the index set over, the stud position is marked from the curb pins

Once you have completed this job we are in a position to prepare and fit the balance spring and make a preliminary assembly, so clean all components thoroughly and re-assemble in preparation for this next process.

Preparing the balance spring

The balance staff will have already been selected on the basis of the internal bore of the balance spring split collet. From the recommended assortment of balance springs, two are possible and these are illustrated. Both are too long to give 18,000 bph for the balance wheel as dimensioned, but this is no great problem as they are also too big in diameter (the balance spring should be about half or a little over half the diameter of the balance wheel).



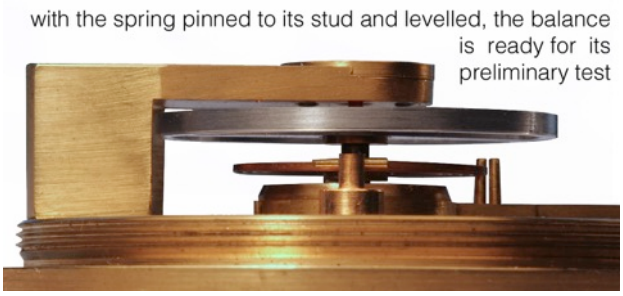
We suggest you choose the slightly wider-spaced 10-turn spring as it will require less turns to be cropped off; in the prototype we found that about $2^1/_2$ turns needed to be cut off to give 18,000 bph, leaving the diameter just over half that of the balance wheel. Care is needed in handling them as all the springs in the recommended selection are of a copper alloy and so are fairly soft; this makes manipulation easy but also means it is easy to distort them unintentionally.

Make sure any burrs are removed from around the balance spring collet hole edges and check the fit. If the collet is too tight it can be opened out by lightly tapping a second-grade tapered smoothing broach into the bore to expand it so it is a firm but gentle push-fit on the balance staff. If you open it up too far, close the collet gently with a pair of pliers. Once it is a nice snug push fit, ease it into position so that the spring lies along the 1.85 mm dia. parallel portion equidistant between the underside of the balance wheel and upper side of the index.

It is now possible to assemble the tool for a preliminary trial fitting to check all is well. As it will be necessary to assemble and disassemble the balance several times, it is probably best not to lubricate the balance staff pivots at this stage as the oil will only attract dirt.

Referring to the photo, note particularly that:

- the gap between the curb pins allows the balance spring a slight freedom ($1^1/_2$ to 2 times the spring thickness)
- the balance spring is neatly pinned to the stud, and
- the balance spring is flat and level, which is achieved by adjusting the axial position of the balance spring collet on the balance staff and ensuring the D-shaped taper pin has not rotated in the hole in the stud to cause the end of the spring to be twisted).


with the spring pinned to its stud and levelled, the balance is ready for its preliminary test

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