A balance vibrating tool – 6

by Guy Gibbons

The screws

The ability to make screws is one of those skills essential if one is to become a true master of restoration work. Commercial replacements may not be available, and when only one screw is required, it is often far quicker to make a replacement than spending hours searching for a suitable ready-made screw.

Some screws are easier to make than others, and by far the most challenging is the countersunk screw. Indeed, it can be said that if you don't have to make or fit a countersunk screw, don't. With a little careful design, it is possible to engineer out the need for countersunk screws in many applications. For our vibrating tool countersunk screws are not essential and could be designed out (for example, by increasing the casing height slightly). But this design shows countersunk screws, mainly to enable students to practise their manufacture and become aware of the difficulties, which we will be highlighting.

Materials required

- length (165 mm) of 4 mm dia. silver steel rod
- length (165 mm) of 2.5 mm dia. silver steel rod
- length (15 mm) of brass bar about 6 mm dia. (to suit the largest collet you have).

Design and drawings

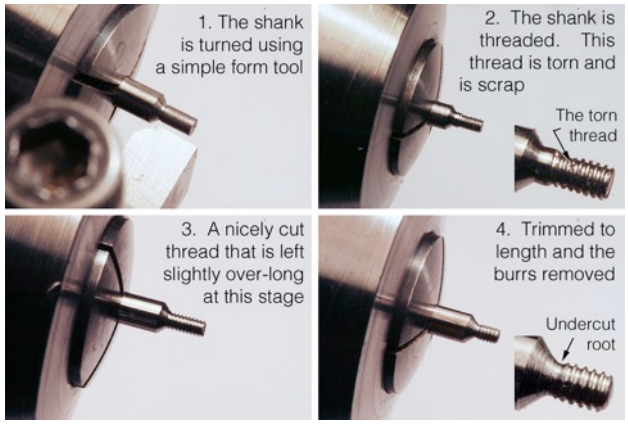
The screws are shown in the drawing. Dimensions are given but you may find it necessary to adjust the lengths to give the perfect thread tip protuberance for your components.

Construction

The manufacture of the 8 BA cheesehead balance cock securing screw will not be described as it is relatively easy compared with the countersunk chaton securing screws.

For the chaton securing screws, the first machining operations are shown in the sequence of photographs. A toolpost on a cross slide is being used, but you could equally well use a graver, in which case the major diameter of the screw and the underside of the head are shaped by manipulating the graver on the 'T' rest.

If using a toolpost and cross slide, you should grind up a simple form tool at 45 degrees so that the underside of the head is formed at the same time as the shank, as to use a set-over top slide set over at 45 degrees will be very inconvenient. Turn down the end to the major diameter of the thread you will be using. If anything, turn it 0.02 mm smaller in diameter as this will reduce the likelihood of the threads being torn by the die.



Some authorities suggest that a slightly undercut root to the head is not necessary, but it does help to ensure that the underside seats properly in the countersunk recess in the chaton, as well as providing an opportunity to remove the burr thrown up at the end of the thread by the thread-cutting die.

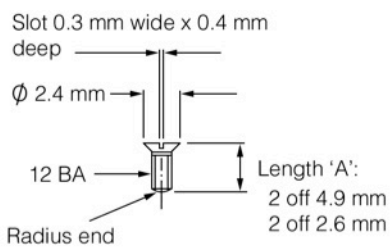
At this stage the screw should be slightly long (by about 0.3 to 0.5 mm); not only does this give us a 'trimming length' but also allows us to remove any poorly formed thread a. t the end caused when the die starts to 'bite' into the work (At the start, the die is not self-feeding and for the first thread or two relies on operator pressure to get it to advance forward.) Moreover, measuring the length specified on the drawing is not easy as there is no clear datum plane under the head. The screw will be brought to its final length during trial fitting.

Now cut the thread using a die of the correct size. Adjusting the die was covered in the Technician Grade so we will not repeat it here. For the two shorter screws you should reverse the die to get a full depth of thread right up to the head. Do not be tempted to by-pass this step as the lead-in on some dies can be quite long which will make the screw a tight fit in its hole. We want the screw to become tight when the underside of the head starts to clamp the two components together. Worse still, do not be tempted to start the thread with the die held in reverse; having no lead-in all you will do is chip the end tooth of the die rendering it useless for anything other than for making torn threads.

Clean up the ends with a touch from a fine needle file (with handle) and check the fit in a master threaded hole such as a piece of 1.6 mm brass plate previously drilled and

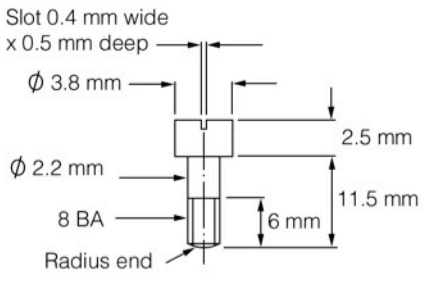
CHATON SECURING SCREWS

4 off silver steel. Harden and temper



COCK SECURING SCREW

1 off silver steel. Harden and temper



tapped with the tap you are using for the index retaining clamp and balance cock. Adjust the split die until the fit is shake-free; if it is loose or the threads are torn, cut off the silver steel rod and start again.

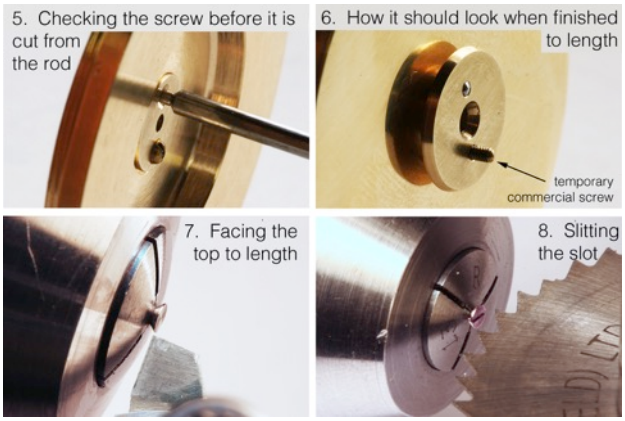
Torn threads

Torn threads can be caused by several factors:

- the die is not sharp (remedy: buy a new die),
- the diameter of the rod to be threaded is above the major diameter of the thread so there is nowhere for the metal to go (remedy: make the shank 0.02 mm smaller than the major diameter),
- the chips have not been cleared by reversing the die every half turn (remedy: clear the chips regularly),
- cutting lubricant has not been used (on steel, not normally necessary for brass) (remedy: apply a little cutting compound or spot of oil),
- the die is not presented square to the work (remedy: use a tailstock dieholder and make sure the die is seated truly flat).

Once you have a clean, tear-free thread, make sure there is no roughness to the crests of the threads, treating them with a fine needle file or stone if necessary.

This is the last time you will have easy access to the underside of the head, so make sure it has a good finish and is at the correct 45 degree angle. Before cutting off the rod, it might be prudent to check that the thread size is correct for your application, which will also enable you to check that the length is slightly over-long. Remove the rod from the collet and use the excess length as a handle to screw it into the components (see photos). Once satisfied remove from the collet for the last time, and holding the rod in a vice saw off just above the head.

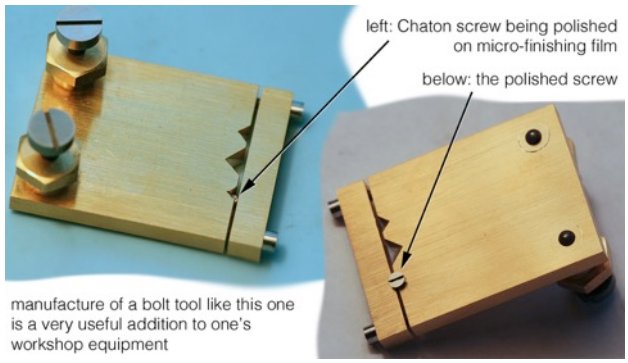


The next step is to turn the head by gripping the screwed thread in a collet. Using very gentle cuts, face off the head until the 2.5 mm diameter is just about to disappear. Deburr the sharp edge.

The slot must now be cut. A slotting file will probably be too large for this size of screw, so if you are not able to use a slitting saw in a lathe or milling machine you must cut the slot with a piercing saw. Keep everything as clean and sharp as possible, as any unevenness in the slot of a screw head is very visible in the finished article. Remove the burrs from the underside of the head thrown up by the slotting operation.

Hardening and tempering

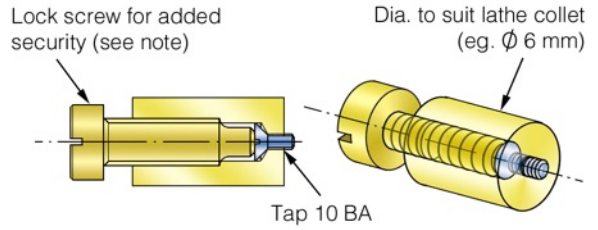
The next process is to harden and temper the screw, which we must do if we want it to take a high finish and to minimise bruising of the slot by the screwdriver. Heat the screw to cherry red head and quench in water. Put the screw in a bolt polishing tool and polish the head so you will be able to see the temper colours during the next operation. Using a blueing plate slip the screw into an appropriate hole and heat to blue before immediately dropping the screw into water. By tempering on a blueing plate with the flame applied to the underside, the tempering colours to rise upwards so the tip will be softer (the hardness let down more) than the head, which is what we want in order to trim the thread to length later on. Clean off loose heat scale and dirt, making sure you get all the dirt out of the threads, and dry well. Return the screw to the bolt polishing tool and give the head a preliminary polish so that it is flat all over and free from any remaining turning marks.



Once you have made one (or both) pairs of screws, they need to be brought to length. To do this, the countersinks in the chatons need to be finished. Fit the appropriate chaton to the cock or baseplate and fit the chaton using the screws you have just made. The top of the head will probably stand proud of the surface. Check that this is not because of dirt under the head, a curl of swarf from the slot-slitting operation, or stiffness in the thread or clearance hole. Separate and increase the depth of the countersink in the chaton slightly and in stages until the head is just level with the top surface of the chaton. Make sure the countersunk hole is round and free from chatter marks. There should be a short length of thread protruding beyond the cock or baseplate, which needs trimming off so that the domed end of the screw just stands 0.1 mm proud of the surface. Measure or estimate how much needs to be taken off and make a note of it.

To hold the screw for turning the end, a sort of 'stud box' is needed, which is simply a 6 mm dia. piece of brass (or the largest size that that will fit in you lathe collets) about 10 mm long. Assuming it is exactly 10 mm long, centre and drill through the tapping size for your screw (1.05 mm for a 12 BA screw). Open out the hole to 2.6 mm dia. for a depth of 8.8 mm and tap the residual length 12 BA. If you will only be taking light cuts with a very sharp tool that is all you need to do, but for added security the 2.6 mm dia. length should be threaded 3 mm or 5 BA to take a brass lock screw.

STUD BOX FOR HOLDING SCREWS



Note: A 6 mm collet may not have a through bore of 6 mm dia. If so, the head diameter of the lock screw will need to be reduced so it passes through the collet bore.

You can now fit the chaton securing screw so that it protrudes from the end of the stud box, and tighten it well. Lock it into position is you have made a lock screw. You can now turn the end of the steel thread to the correct length and dome the end, finishing the dome with a burnisher. When reducing the thread to length, bear in mind that the screw tip has been tempered so you are effectively turning a tougher steel. Do make sure you have tempered the tip of the screw; if you have left it dead hard, all that will be achieved is a blunt tool. Those using a carbide graver will have less of a potential problem.

After removing the screw it can be returned to the bolt polishing tool for final finishing of the head, which should be brought to a mirror finish.
