Making an alternative "Taylor inspired" bass drone

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Motivation

Bass drones made by Billy and Charles Taylor of Philadelphia via Drogheda, as exemplified by the Cummings and Scott sets described by David M. Quinn in the third of a series of articles[1], are of an attractive and engaging design. However, as David points out in his article, the design of the original bass drone for the Cummings set presents some problems for the modern maker. Firstly, and most importantly, the original bass drone stand features metal-inside-wood joints which are inevitably prone to cracking. Secondly, the original bass drone slide turnaround uses a large cast metal piece of (if I may say so) somewhat dubious aesthetics. David's use of Delrin plugs for the tenons solves the first problem, though the use of nontraditional material may strike some as less than ideal. It also introduces a certain complexity to the construction.

Though the Taylors were clearly comfortable with "non-traditional" techniques, I found myself wishing that the metal tenons could be eliminated from what was otherwise an elegantly simple standing joint. Similarly, the options presented for the slide didn't catch my fancy - the "double bar H" design seemed too heavy, and the 'J' bend seemed to me out of keeping with the Taylor brothers' work. Could there be an alternative design for the slide that kept the "feel" of the Cummings' slide without requiring the heavy cast metal piece? Lastly, attempting to retain some of the ornamental aspects of the Cummings bass slide, while avoiding the use of metal-inside-wood in the connection between brass and wood, presented another challenge. The standard 'H' and 'J' options seemed a bit spare beside the rest of the Cummings set's mounts, but making a metal thimble seems to preclude the addition of a mount at the outboard end of the timber section.

In the end, I came up with something which pleases me and which I think evokes the Taylor style while avoiding the features which might arguably be called pitfalls. Most importantly, the design seems to perform well musically.

Overview

My design eliminates the metal tenons and presents the "standing joint", e.g. the entire bass drone except for the slide, as a single piece of timber, with a narrow metal ring at each end, and a single mount on each tenon. As in the Taylor original and DMQ's reinterpretation, the standing joint contains three bores which "double back" on each other via two short cross-bores. Like David, I turn the outside round, rather than shaving it into a triangular cross-section as the Taylors did.

My design uses a timber slide, and because the slide tenon is also wood, the inside of the timber slide must necessarily be a little larger than the original in order to accommodate it. This no doubt alters the acoustics of the end product, but not adversely as far as I can ascertain. I should probably mention at this point that although I arrived at my design in blissful ignorance of this fact, I have since been informed by Wilbert Garvin and others that R. L. O'Meally used a similar all-wood triple bore standing joint in his early 20th century sets[2]. I have since encountered two drone stands from modern makers with alternative shuttle designs that were entirely concentric on the outside; one with a triple bore routed from solid timber and then re-laminated, by Andreas Rogge, and one by Brian Howard with a metal slide tenon, of what internal construction I can’t say.

Illustration 1: The completed standing joint, without mounts

In my own design, as well as David Quinn’s, the end of the timber slide attaches to the metal portion of the slide via a "thimble", ensuring that in the wood-to-metal joint the wood is in compression rather than tension. Since it is difficult if not impossible to attach mounts to the 'H' joint in this configuration as a result, I rely on the second metal "strut" connecting the 'H' for the decorative elements of the "outboard" half of the slide. Rather than make a 'U' shaped mitered joint at the end, I choose the 'H' shape so that end plugs can be added in the manner of the Taylor original. However, instead of relying on a single cast piece of metal to incorporate both the connecting bore between the straight sections, and lend the slide its rigidity, I rely on one mitered cross-piece for the bore, and a second smaller, ornamentally turned brace near the 'thimble' for support and visual balance.

One advantage of the "H" type design for the drone slide is that if the slide falls onto the floor, as is prone to happen now and again, one of the end 'plugs' is likely to strike first. If you use boxwood or staghorn mounts, as I do, probably no harm will be done; if the mounts are artificial ivory, and crack as a result, it is easy enough to replace one, provided you didn't use a permanent glue to hold them in place. I steer clear of permanent glues in general [3].

Special considerations

There are a few special challenges in making this style of drone, though none are terribly daunting if care is taken. Firstly there is the matter of drilling the parallel bores, which requires careful setup and for which pneumatic gun drills are strongly recommended. Work holding is important at the chuck end of the lathe, since any rotation of the stock in the eccentric hold during boring will spell disaster. The fact that the turning does not proceed evenly from largest-to-smallest diameter from start to finish, and the fact that the diameters being turned are not concentric, mean that the order of operations is very important. In making the standing joint, you will be turning the work around four separate, hopefully parallel, axes.

It is also very important to plan out the lengths of the various sections, because some of the tenon diameters intersect one another when viewed end-on. This means, for instance, that when turning the outside of the main 'standing joint', *one must not yield to the temptation to turn the entire workpiece to a uniform cylinder* of 25 mm. Lastly, since most of the time the workpiece will be significantly off-center[4] while making this project, lathe speeds should be kept quite low. With the exception of the initial turning of the center 'stand' section, I would not advise a speed above 400 RPM.

At the risk of being redundant, the key areas to take special care with are:

- planning and executing the steps in the right order;
- placing the work carefully and holding it securely in the chuck;
- careful centering of each bore, preferably with a template;
- carefully planning the places where the cylindrical sections meet (i.e. where the tenons meet the stand), to ensure that the cylindrical forms do not cut into one another excessively.

Lastly, remember that at key stages, extra length is required at the ends of the workpiece to allow a bearing surface to be turned for the fixed steady rest.

The primary challenge of the drone slide section, beyond what is ordinarily involved in making a timber slide with a tapered ferrule, comes in soldering the metal section. A jig may be helpful in holding the piece, although I manage with some strategically placed iron binding wire and some small concavities that help hold the reinforcing strut in place. Also, since it is unlikely that the entire metal section will be soldered in one step, both 'hard' and 'easy' solder will be required.

What you will need

- A lathe with at least 500mm between centers (a slightly overhanging tailstock is OK)
- A sturdy, independent 4 jaw chuck with a capacity of approximately 60 mm
- A compressor delivering 90 - 110 psi and connections
- 3 gun drills, at least 20" usable length, diameters 3/16", 6.2mm, 5/16".[4]
- A fixed steady with 3 point bronze bearings or roller bearings
- A tailstock chuck
- A small quantity of 0.9 to 1.0 mm sheet brass, silver, or nickel silver
- 15mm brass rod, 30mm or more in length
- Brass tubing, 3/8” or 10mm I.D., or sheet metal and a mandrel for hand-rolling rolling 9.5mm I.D. tubing
- Silver solder in both 'hard' and 'easy' grades. flux, and a suitably hot propane or butane torch
- One or preferably several pieces of suitable timber, 40 x 40 x 500+ mm
- Timber for making the timber slide section, approximately 25 x 25 x 200 mm
- A means of boring the slide socket to about 13.5 mm, and reaming the socket to its final size of about 14.6 mm
- A tea kettle and leaves for making the infusion of your choice.

No doubt an industrious individual could manage with substitutions for many of these specific items; after all, neither O'Meally nor the Taylors had pneumatic gun drills. However my own feeling is that I would not want to undertake this project without the above equipment. Making a triple bore with D bits will tax even the most patient modern craftsman.

Step by step procedure for making the standing joint.

Roughly divided into four "stages", one per axis of revolution

1.1. Find the center of the timber billet and mark out the plan for the three bores and outer cylindrical barrel on both ends of the piece. Plan the lengths of the three main sections - reed tenon, barrel, and slide tenon, allowing extra length at each end for chucking and for forming the eccentric bearing surfaces (see discussion above). Mark the two end positions of the barrel section on the sides of the billet. Mark the sides of the billet nearest the mid-joint and reed tenon bores with the corresponding diameters, i.e. '6.2mm' and '3/16"'. The reed tenon should be about 55mm long, with at least 25mm added to the end for chucking. The barrel section should be 240mm long, and the slide tenon about 130mm long. (The rest of the billet will be used to form bearing surfaces in the fixed steady rest, so leave it long).

The end-view plan I use is shown in Figure 2. The bore diameters are 3/16” (reed tenon, o.d. 15mm), 6.2 mm (mid bore), and 19/64” (slide tenon, o.d. 14 mm), with a barrel diameter of 27 mm (with beads extending about 2mm larger in diameter). The figure is inscribed inside a 40 mm billet; note that due to wander during boring or other modifications, the outer diameters of the tenons may extend outside the nominal barrel diameter as shown in *Illustration 2.*

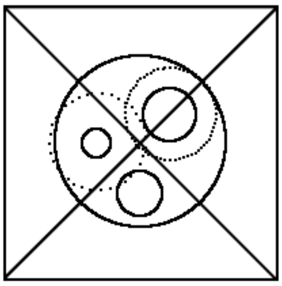

Illustration 2: End plan of drone standing joint bores

1.2. Carefully center the billet in the lathe using the four jaw chuck and tailstock. The lathe cross slide can be used as a simple way of assessing the centered-ness of the billet at the headstock end, if the billet is reasonably square or at least a parallelogram (i.e. even if it has shrunken a bit from the originally rectangular configuration).

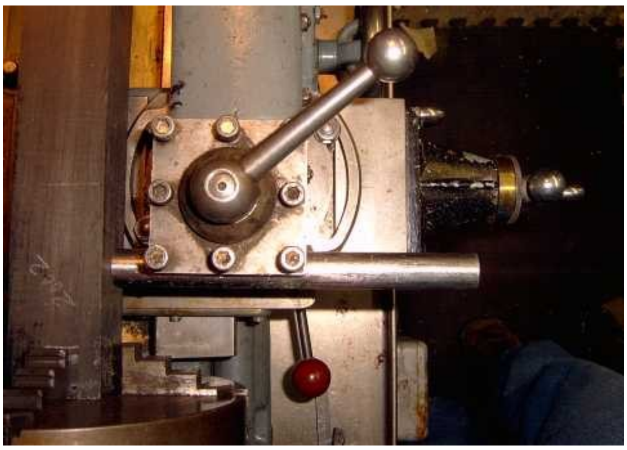

Illustration 3: Setting the four jaw chuck using the cross feed dial

1.3. Gently round of the extreme corners of the billet, except the portion within the headstock chuck, either with a roughing out gouge, spokeshave, or a side-cutting tool mounted in the toolpost. Resist the temptation to turn the billet round - only take down the sharp corners, as the extra timber may be needed in the later stages when turning eccentric sections.

1.4. Turn the center "barrel" section of the billet to a 29/30 mm cylinder, with sharp shoulders where the barrel meets the square section. It is important that these shoulders be square rather than rounded, or you will weaken the finished piece at the junction of the eccentrically turned sections.

1.5. Mark out and turn the decorative beads at the ends of the barrel, turning the rest of the barrel down to 27 mm. Turn the coves between the beads, being careful not to go too deep (i.e. not below 25 mm diameter). Turn the outermost ends of the barrel to between 25 and 25.5 mm diameter; these sections will eventually be covered by narrow ferrules. You may wish to turn a couple of incised lines at each end of the barrel, just inside the turned beads.

1.1. Smooth and seal the barrel section and apply sealer and one or more layers of finish (if desired) to the barrel, leaving the under-ferrule sections bare. This will be your last opportunity to refine the barrel exterior on the lathe; we won't be turning the piece around this center again (*Illustration 4*).

Illustration 4: The completed barrel section

2.1. Working from your end-view plan, determine the offset to apply to the billet so that it rotates about the "mid joint axis". The mid-joint axis lies along the center of the "middle bore", that is the bore which does not include either the reed tenon or the slide tenon. On my plan the offset is approximately 5 mm along one axis, i.e. Two opposite chuck jaws are each moved 5 mm, and the other two chuck jaws remain in their "centered" position. Check to see that this corresponds to the offset of the mid-bore as marked at the tailstock end, and place the tailstock center in the billet at the center of the mid-bore, i.e. the lowermost hole in Illustration 2. Then using either the bubble-level technique or the cross-slide technique, check to see that the billet runs "true", i.e. that each face of the billet is offset a constant distance along its length. As errors in setup at this stage can be hard to correct, this would be a good time to boil the kettle and have a cup of tea. When you come back, re-check your setup before proceeding.

2.2. With the billet securely mounted in the headstock chuck and on the tailstock center as above, and the lathe on a medium-slow setting (400 rpm or less), carefully turn a short section of the billet, adjacent to the tailstock, to a round bearing surface concentric with the middle bore. Given its offset from the billet's center, it's likely that the maximum round surface you can obtain here is less than 22 mm, but it should be at least 15 to 18 mm in diameter. Keep this bearing surface short, say less than 20 mm unless your starting billet length was greater than 500 mm, since you will have to cut it away and thus your billet is getting shorter...

2.3. Mount a fixed steady such that the points or rollers bear against the cylindrical surface you have just turned. If you're using a three-point fixed steady without rollers, some hard wax will help lubricate the surface and reduce heat buildup. Release the lathe clutch and turn by hand to ensure that the piece rotates freely without fouling any part of the steady or toolrest. It pays to do this every time the centerline is changed or the toolrest holder is moved significantly, since an error here will probably spoil the piece; in particular when using ebony, any sudden torsional forces or impact will probably cause the piece to splinter.

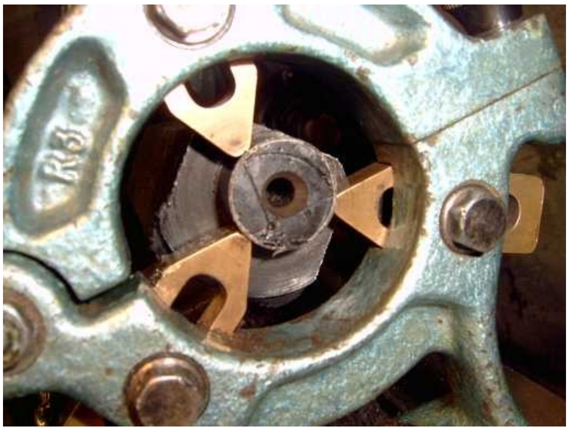

Illustration 5: The bearing surface in the fixed steady, with the pilot hole bored

2.4. Turning the billet at medium speed in the lathe, drill a pilot hole from the tailstock, using a center drill and following up with a twist drill, to about 20mm depth. Remove the tailstock. Measure the distance from the tailstock end of the billet to the "left hand" shoulder of the barrel section plus 2 or 3 mm, and mark the gun drill. Drill with the 6.2 mm gun drill (with the compressor running at approximately 90 psi) to this depth. You have now formed the first of the three parallel drone bores. Remove the steady rest and carefully saw away the wooden bearing surface.

Illustration 6: The middle bore, seen from the headstock end after boring, showing some drift

3.1. Repeat steps 2.1 and 2.2 for the reed tenon bore. Adjust the position of the bore slightly to compensate for minor drift that may have occurred while drilling the mid bore. This 3/16" bore will be offset towards one side of the billet, 90 degrees or one quarter turn relative to the previous bore. Double-check the position of both ends of the billet, and turn a bearing surface at the tailstock end. Drill a 3/16" pilot bore with the tailstock chuck as before, then remove the tailstock and drill with the gun drill full-length, until the drill exits at the headstock end.

3.2. Reverse the billet, taking care to mount it with the 3/16" bore along the centerline. Center the tailstock in the exit hole; this will ensure that the reed tenon bore is perfectly concentric at the tailstock end. We will now turn the reed tenon itself. Release the clutch and turn the billet by hand before starting the lathe, making sure that the piece turns freely. Very carefully start to turn away the parts of the billet farthest from this bore's axis. You will be making highly interrupted cuts, so go *very slowly* and use a rigidly mounted tool in the cross-slide with minimal overhang; however make sure that there is enough overhang that the tool holder does not foul the shoulders of the billet as you proceed inwards. Take care not to turn away the sharp corners or flat sides at the tailstock end - leave a 20 mm section or so of the billet square, as this will continue to provide the surface against which the square chuck jaws hold the workpiece when you turn the billet around again in order to drill the last of the three bores. Holding an eccentric workpiece rigid against rotation in the chuck via a cylindrical end is very difficult in practice and I don't recommend trying it - the square faces do the trick. This is a stage which requires patience and concentration. One hasty twist of a feed screw, or advance of a tool in the wrong direction, will cause a massive catch and can destroy the workpiece. This is also why I recommend doing this stage of the operation using machining techniques, e.g. with a rigidly mounted tool as opposed to hand-turning. As the cut becomes less interrupted and more nearly a complete rotation, you can slightly increase the feed rate, but always use caution near the highly eccentric shoulders. If you find that the shoulders are becoming rounded or sloping, you can square them up with a careful narrow cut using the cross slide to advance the tool perpendicular to the axis of rotation.

Illustration 7: Turning the reed tenon

3.3. As you cut deeper, you will encounter the end of the previous "middle bore" near the barrel shoulder. Don't worry about that, as it will be sealed at the end of the operation and the barrel end will be covered by a mount; however this is why we drilled the middle bore "blind" rather than boring straight through the billet. If you drill the mid bore straight through, you may have to turn the reed tenon to an unacceptably small diameter in order to clear the previously bored hole. A small reed tenon may suffer accidental damage too easily. On the other hand, if the reed tenon is too large and overhangs the barrel too far, it will be impossible to fit a metal ferrule over the end of the barrel. I like a reed tenon of about 15 mm.

3.4. Once you have formed the reed tenon to your desired size, turn a shallow recess for thread wrapping and apply some thread chasing. Then turn a shallow chamfer at what will be the

Illustration 8: Slide tenon end plan

finished end of the tenon; we will cut the square piece away with a saw after turning is complete.

4.1. Reverse the billet again, placing the square section at the reed tenon end in the four jaw chuck. Decide on the placement of the last of the three bores, based on the original plan and making adjustment for any drift that may have occurred in the other two bores. Center the tailstock in the center of what will be the slide tenon, and check to see that the billet is parallel (though offset) to the axis of rotation as you did in stages 5.2.1 and 5.3.1. Ideally this bore will lie along one of the billet "diagonals", i.e. offset towards the billet corner which is opposite the faces marked '6.2' and '3/16"' in step 1.1.

4.2. Turn a bearing surface at the tailstock end. Take your time, as the billet overall is more fragile than it was in stage 3 and is being "driven" by the relatively narrow tube of timber at the reed tenon end. You will certainly encounter the previously bored holes of 6.2mm and 3/16" diameter, and will probably not be able to turn a complete bearing surface which includes all three bores and has no flats; you will probably need to turn the cylinder down until you have just turned away the last of the previous bores, in order to get a clean bearing surface. The resulting cylinder should be at least 12 mm in diameter. If it is not, then your slide tenon outer diameter will be too small and its walls will be excessively thin. Bear in mind that this bearing surface may be very near the final slide tenon diameter. You may choose to cut the slide tenon to its final length at this stage before forming the bearing surface, so that the tenon's exit can be chamfered as part of the pilot hole process.

4.3. Turn the slide tenon partway down at this stage, or just after pilot boring (below) to 20 mm or so; this will reduce the stress on the long, relatively thin-walled slide tenon when finish turning it after boring.

Illustration 9: Turning down the slide tenon before final boring

4.4. Drill a pilot hole as before, including a small chamfer at the tenon exit. Remove the tailstock and drill with the 19/64" gun drill, working slowly and steadily until the drill exits through the 'shoulder' at the reed tenon end of the barrel. It's a good idea to mark the drill's length at the approximate point where you expect the drill to "break through", so that you can reduce the feed rate and avoid any mishap as the drill emerges. Congratulations! You have now completed three parallel bores in your barrel, and are ready to complete the slide tenon. This is a good time to take another break.

4.5. Remove the steady rest and re-mount the tailstock center. Carefully turn the slide tenon to its final size, using extra caution at the barrel shoulder. If the tenon overlaps the barrel diameter somewhat, you may find files useful in cleaning up the edges which are difficult or risky to clean up with the turning tool. As with the reed tenon, I recommend using machining techniques and a toolpost-mounted tool for this, especially near the barrel shoulder. This also makes it a bit easier to maintain a constant diameter along the tenon, although this is less critical than having a constant inner diameter in the drone slide socket. When the tenon is turned to size, turn a recess about 0.5 mm deep and 30 mm long for the thread wrap, and apply a chasing tool. Alternatively, if you have no chasing tool, a v-profiled turning tool in the toolpost holder can be used to form a series of incised lines, and the toolpost cross slide can be used to keep them evenly spaced, say every 1.5 mm or so. Chamfer the outside edge of the tenon slightly. Complete the tenon using successively finer grades of abrasive paper, etc. and apply finish if desired. It's probably best to leave the section with thread chasing bare - if you do seal or finish it, a small amount of shellac or other sticky material may be needed to adhere the first layer of thread wrap to the tenon.

4.6. Remove the piece from the lathe, saw away the square block which was used for workholding in the chuck, and ream the reed seat. You can ream the reed seat by hand, if you are careful to keep it parallel with the bore, or you can mount a reamer in the lathe chuck (a three jaw centering chuck may be more convenient that the four jaw chuck for this operation) and hold the workpiece in your hands. If you use the latter method, work slowly and carefully to avoid losing your grip on the workpiece, since the eccentricity of the reed tenon is liable to cause it to be damaged if it catches on the reamer and rotates.

5.1 You now have a standing joint containing three parallel bores, and two tenons. At each end of the barrel, the bores which aren't forming a tenon need to be connected to one another. The most straightforward way to do this is to drill a blind cross-bore at the ends of the barrel that will be covered by the metal ferrules. Making the cross bore "blind", that is, not drilling completely through the barrel, but stopping at the second bore, means that only one exit hole needs to be plugged. I drill the cross bores to the smaller of the two relevant diameters in each case, in other words at the slide tenon end I connect the 3/16" and 6.2mm bores with a 3/16" cross-bore, and at the reed tenon end I connect the 6.2mm and 19/21" bores with a 6.2mm cross bore.

5.2. In order to make the three bores behave as a single, airtight bore, the exit holes must be plugged where the cross bores have been drilled. There are various ways of doing this. The most permanent solutions, such as epoxy fillers or permanently glued wood plugs, have the disadvantage that the drone cannot be serviced afterwards, even to remove debris that finds its way into the bore, and if the glue itself goes astray the bore is likely to be constricted or blocked and impairing the drone's function. For these reasons I prefer to use removable materials for the plugs, even though they may entail more maintenance in the medium term.

The ends of the parallel bores can be blocked effectively with cobbler's wax or a mixture of cobbler's and sealing wax, trading off the properties of softness and brittleness. In order to keep the wax from blocking the cross bore, the drill bits used to bore the cross bores can be used, inserting the solid shanks of the bits into the blind holes. Then the warmed wax can be inserted into the end holes where it will harden and form an airtight seal.

David Quinn has reported that he uses a cork layer between wax and bore in a similar setup, and this seems a reasonable solution as well, though forming a cork plug of the right size is a bit tricky.

Once the ends are plugged, there remains only one side-hole at each end of the barrel which needs to be plugged. A softer material can be used here, as the result will be covered by a metal ferrule. In fact, it may be practical to form a seating surface on the outside of the timber and place a thin leather "gasket" over the hole instead of attempting to fill it. Either way, the goal is to form an airtight seal which doesn't obstruct the cross bore. I have even used shrink wrap tubing with a hot-melt glue backing to seal the cross bore and provide a snug fit for the metal ferrules, and have to say that I don't have a strong opinion on which of the above solutions is best.

5.3 Form the ferrules from sheet metal approximately 0.8 to 1.0 mm thick. Make sure that they are tight fitting, either directly over the timber at the ends of the barrel, or over a leather gasket or thread packing as you prefer. An air leak from beneath the ferrule can cause subtle performance problems in the finished drone, such as instability of pitch, weakness of tone, or shutting off.

inner metal tube surround a plug machined from brass, rather than timber. The whole assembly is joined with silver solder, and the thimble may then be joined to the timber part of the bass drone slide with a tight thread-packed joint. I find that the

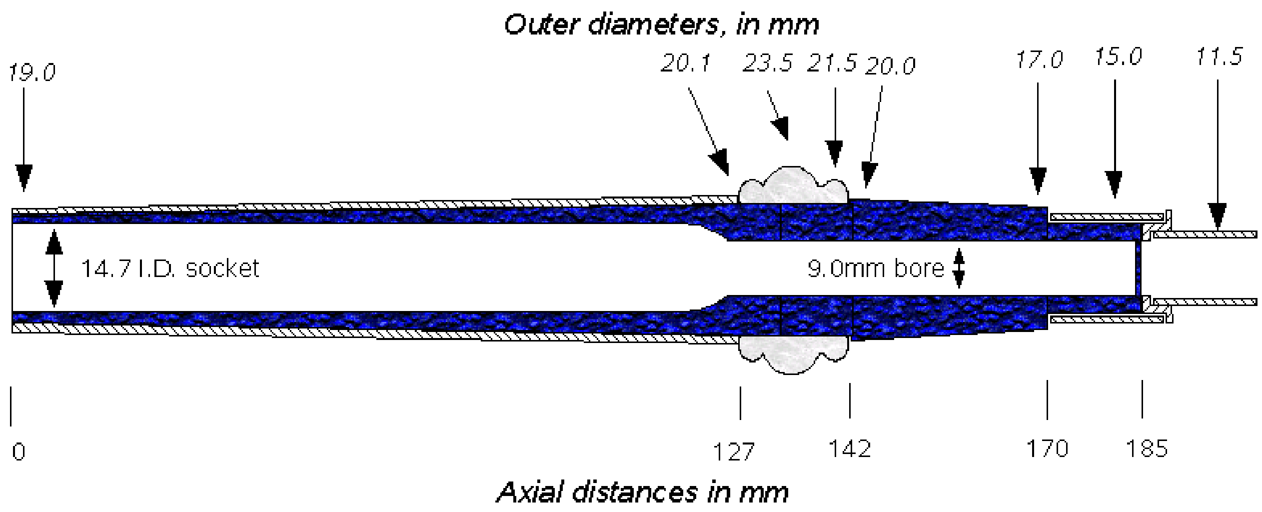

Illustration 10: Sectional view of the slide joint

The ferrules may be slightly tapered, if the barrel ends are themselves tapered, or they may be cylindrical - it only matters that they are a good snug fit, and that they can be fit over the shoulders of the tenons. If the tenon shoulders overlap the barrel diameter somewhat, fitting the ferrule may require slipping it on at the tenon end first, then stretching it slightly over the opposite side of the barrel. Either some 'give' in the packing, or a bit of gap-filling adhesive such as cobbler's wax, may be in order.

The slide joint: modifications to D. M. Quinn's suggested design

My own answer to the original Taylor bass drone slide on the Cummings set involves a wooden slide socket, scaled up to fit the wooden slide tenon on the standing joint, a modified one piece metal "H" section, and a puck.

The timber slide is bored and fitted with a tapered ferrule according to David Quinn's instructions in his original article.

The union of a timber slide and the metal 'H' section is made with a 'thimble' connection. Since the wood and metal have different thermal expansion rates, and the wood will shrink and expand with humidity changes whereas the metal will not, to do otherwise would ensure that the joint is either chronically loose, or the timber cracks, or both. The aim of the thimble is to ensure that the metal is on the *outside* of the metal/wood joint, thus keeping the cross-grain wood in compression rather than tension.

In the thimble, the outer metal ferrule and the

whole business works a bit better if the ferrule is slightly tapered, so I form it from sheet metal on a mandrel. In order to prevent the joint from coming apart when the rest of the soldering is done, I use a 'hard' or higher-temperature grade of solder for the ferrule seam, and 'easy' solder for attaching the plug and tube. The fact that easy solder usually has better gap filling properties is also helpful in keeping the thimble 100% airtight.

I designed the H joint with an ornamental strut reinforcing the straight "cross bar" of the H, and made the sections of the "H" past the cross bar fairly short. The end plugs are designed to fill these "legs" of the H such that the resulting bore remains approximately cylindrical; this eliminates the possibility that standing waves could be set up in the short end plug sections.

Illustration 11: A completed bass drone with its slide joint

I make this metal piece in two stages; first I make the section comprising the thimble and the first straight section. Then I drill side holes of 9mm diameter in the long straight sections, where the cross bar will sit, and form the cross bar, carefully shaping the ends with a half round file to fit snugly against the outside of the long sections. I machine the decorative cross-brace from solid brass bar; I like to echo the triple-bead design used in the drone mounts here. I find that, with free machining brass bar, beads can be hand turned using a HSS bedan in the same manner as for woodturning, once the rough cylindrical profile has been formed using machining techniques. I form a tiny 'pin' on the end of the cross brace, and drill a corresponding tiny hole in the side of the long brass cylinder to accept the pin; on the other end of the cross brace I form a convex shape which fits against the side of the thimble. I then assemble these pieces, binding them together with iron wire; the pin and convexity on the cross brace, together with the carefully filed cross brace, fits together in such a way that the binding wire can hold the assembly together for soldering (*Illustration 11*). This is a bit tricky to bind with wire however, and a custom-made soldering jig could certainly streamline the process.

Illustration 12: The slide metal section, bound and ready for brazing

One area where I am still breaking my own rule regarding metal inside wood is the drone 'resonator' or puck. I like to make these from boxwood, but this means that the last section of the metal H is a press-fit into the boxwood resonator. Fortunately this joint isn't usually under stress, so it doesn't have to be too tight, and the boxwood seems to be more resilient than, say, ebony. All the same, you may choose to avoid this by making the outside of the resonator a brass "ring" which holds the disc shaped boxwood faces in compression, and soldering this to the end of the long arm of the 'H'. In any case I am making a puck of about 52mm diameter, with an interior hollow space of about 48mm diameter and 9mm thickness. The puck's exit hole is approximately 7.1 mm diameter (as suggested by D. M. Quinn in his original article).

Illustration 13: The completed boxwood puck ready for gluing

Assembly and conclusion

Not much to say here, except that as with all wood-inside-wood joints, I don't advise using teflon PTFE "plumbers' tape" on the slide, since that in fact encourages making a very tight, but relatively slippery, joint. In fact what I prefer nowadays is actually dry cotton thread, which has a nice mixture of softness, compressibility, and just enough friction to hold onto the slide. The compressibility of the cotton seems to help compensate for any small irregularities in the inside of the slide due to imperfect reaming. Some flute makers recommend putting a tiny bit of shellac on the first layer of thread, to keep it from loosening too much.

I use a cane reed of about 4.0 mm inner diameter and 100 mm length, although I've found that other types of drone reeds work well in this design also.

Good luck! - ***Bill***

Notes

[1] David M. Quinn, “Drones by the Taylor Brothers, Part 3”, *Iris na bPiobairi/The Pipers' Review*, Vol XX No. 4, Autumn 2001. Reprints are available from *The Pipers' Review*, charm@seanet.com or in electronic form as part of “Pipes and Pipemaking 2002” (CD-ROM), from David M. Quinn,

[2] In the words of our esteemed Editor, "*nihil novus sub sole est*".

[3] I make exception for bonding the tapered ferrule to the drone slide's timber sleeve - this seems to be one place where it is relatively unlikely that a successful repair will require removing the bond. I reason that if a metal ferrule is damaged badly enough to require repair, more than likely the timber will have suffered an even worse fate.

[4] - i.e. the center of mass will not lie along the axis around which the piece is turning.

[5] - Gun drills are often quoted by 'total length', from which you must subtract the length of the coupling/interconnector section. The mixture of metric and imperial measurements is somewhat accidental; it so happens that these are the sizes which I have come to use with good results. I expect that any bore sizes within about 0.3mm of these should be fine, but if you depart more than that from these measurements, you may encounter significantly different performance (for better or worse). Note also that besides being a risky experiment acoustically, using a larger diameter for the outbound (slide) section may require you to scale up the entire bass drone slide, to avoid making the wall of the slide too thin.