Designing and using a universal router jig for making replica radio backs

by David Taylor

It is one of life's mysteries as to why so many radios have missing back panels. Could it be that a 'phantom twiddler' removed the back from a faulty radio to have a dabble at repairing it, and having not succeeded, didn't replace the back? Or in less safety conscious times, were backs removed to allow more ventilation to prevent sets from overheating, in the hope of prolonging the life of the set by allowing heat from mains droppers and valves to escape? I guess we'll never know! Even when the back is present, it often has chunks missing, due to excess heat damaging it over time, sometimes exposing dangerous high voltage components such as mains droppers.

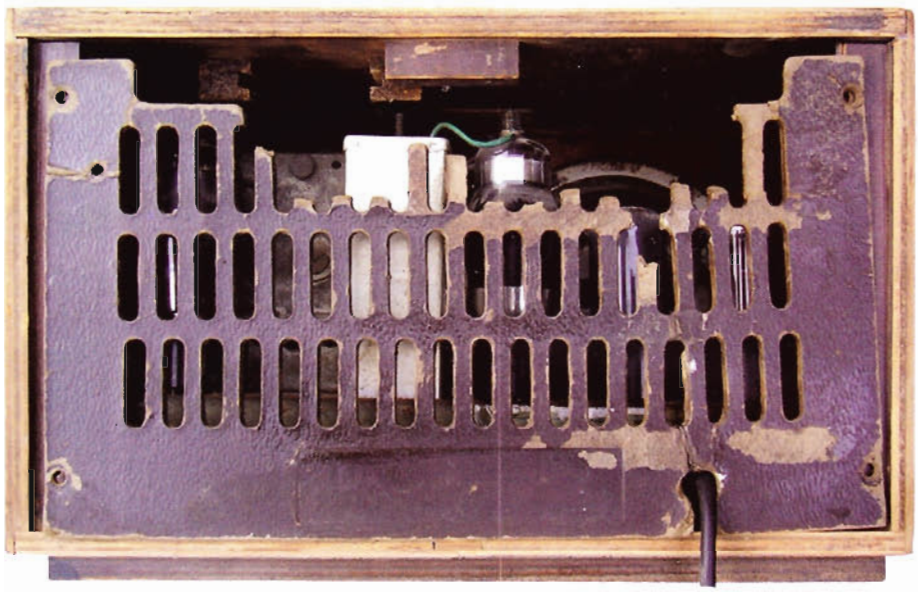

Fig 1: Poor fitting damaged Little Maestro back

Fig 2: Little Maestro with new back fitted

Whatever the reason, missing or damaged backs pose the question of what to do about it. Rarely will a replacement original back in good condition become available, so the next best thing is to create a passable replica of the original, and that's what this article is about.

At the NVCF I bought a post-war AC Little Maestro 'woodie' with an attractive dial and a nice cabinet, albeit a bit worse for wear and with a back in need of replacement. There was enough of the back still intact to enable me to fathom out what it should look like, so I pondered on the options for making a new back, both in terms of time, and the likely end result. I narrowed it down to two options, both of them labour intensive, but the second method has the merit of repeatability and accuracy once a simple jig has been made:

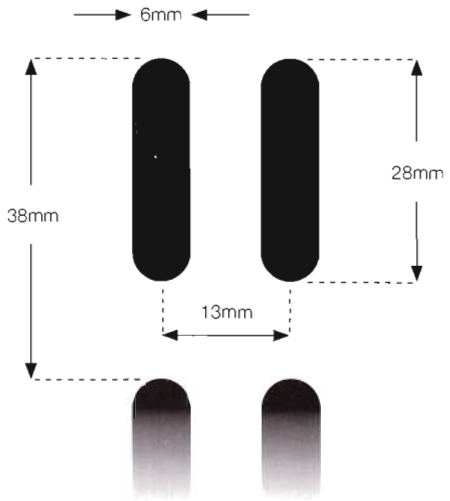

Fig 3: Typical slot dimensions and spacings of UK radio backs, though the length of slots seen to date has varied from 28mm to 25mm & 18mm.
Vertical spacings seen to date are 35mm, 38mm, 40mm & 42mm. (See below for some examples).

Variations seen to date

Model	Slot Spacing	Slot Length
Little Maestro post-war 'woodie'	35mm	28mm
Wartime Civilian Set	38mm	28mm
Murphy U198	38mm	28mm & 18mm
DAC90A	40mm	28mm
Portadyne Princess/Noble	40mm	28mm
Little Maestro T105	42mm	28mm

Option 1) Mark out a blank back panel with the layout of the slots, drill a hole at each end of the slots (54 slots in the case of my 'Little Maestro' – 108 holes), and using a hand-held fretsaw or an electric scroll-saw, saw the 108 sides of the slots, or chop them out with a chisel and mallet. Very tedious and time consuming, and however much care is taken is likely to have disappointing results. Furthermore, if another identical back had to be made, it would be just as laborious to repeat the process. I therefore discounted this option.

Option 2) Make a router jig. This would involve three or four hours work, but once made, by using the jig to guide a router, the 54 slots in the Little Maestro back could be neatly cut in about half an hour and the jig could be used if needed again to make

other backs. To cut the slots simply involves setting the depth gauge on the router to cut through the new back panel, plunging the router in at the top of the slot position, then pulling the router towards you until the slot is cut, then switching off and repositioning the new blank back laterally in the jig to cut the next slot. To cut each slot and reposition the back panel in the jig to cut the next slot takes no more than 30 seconds.

Hence, I opted to make such a jig, and thought this might be of interest to other restorers, as the basic technique could be employed to make similarly slotted back panels for other radios, as has since proved to be the case. I later went on to make jigs and backs for a Portadyne Princess, Murphy U198 and a Wartime Civilian Receiver, which has a total of 83 slots arranged in four rows. To make such a back panel by any other means than a router jig would be a time consuming and daunting task. After having made three separate purpose-made jigs, I had a 'eureka moment' and realised rather than making a separate jig for each model, I could make a 'universal' jig to cater for most smaller radios, including the ubiquitous Bush DAC90A, (22 cms x 29cms), by using a blank panel 30cms (12 inches) square and cutting it to the desired size and shape after the slots had been cut. The pictures in this article show how the universal jig is made and demonstrates the process of cutting the slots. I have shown examples of six different backs that I've made on the 'universal jig'. Figs 1 & 2 show the original damaged 'Little Maestro' back, and the replacement I made, which inspired me to make other backs, and later, the 'universal jig'.

The design criteria for the router jig are:
To hold the blank back panel in position while each slot is cut with the router.
To enable the panel to be moved into the next position for each new slot to be cut.
To limit the travel of the router to enable the correct length of slot to be cut. (i.e., 28mm, 25mm, 18mm).

To enable the router guide to be re-positioned to cut subsequent rows of slots.
To be adjustable to cater for different vertical spacings from one row of slot to the next, and different slot lengths.

Once the concept of the jig is understood, all that is needed to make and use it are basic woodworking skills, and a cheap DIY store router, which often sell for under £25.00. While they're not up to the more demanding router tasks, such inexpensive light-duty routers are fine for this sort of thing.

The components of the jig are:
A baseboard, 1 Metre (39 inches) x 90cms (36 inches) e.g, 18mm chipboard loft floor pack of three.
Two 'fixed guides'1 Metre x 30 cms (12 inches), made of strips of material of the same type and thickness that the new back panels are to be made of.
Two 'lateral guide panels', 32.5 cms (13 inches) x 30cms (12 inches), again of the same material as the new back panel.
A 'router sole plate guide', 60cms (24 inches) x 17.5 cms (7 inches) made from 10mm or 15mm MDF, with an aperture cut to suit the 'footprint' of the router sole plate, as described below.
Two 'filler pieces' - one 3mm thick, the other 10mm, to fit the aperture in the sole-plate guide to limit the length of travel of the router for cutting slots shorter than 28mm. (i.e., 25mm and 18mm).
6mm Dowels.
Screws.

Fig 4· Underside of baseboard

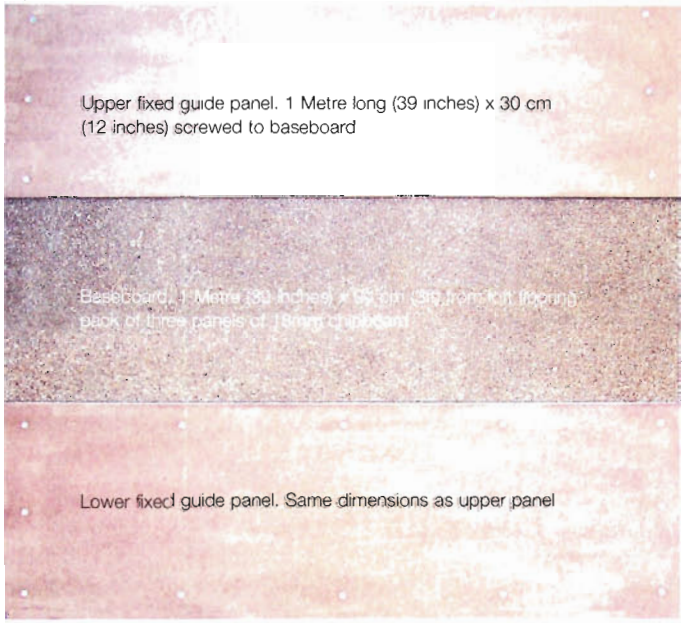

Fig 5: Top of baseboard

DIY stores often sell off-cuts of MDF and chipboard cheaply, but the small amount needed isn't expensive even if bought new. A 'loft panel pack' of three 18mm chipboard loft flooring panels 1.22 Metres x 320mm from a DIY store is ideal for the baseboard and will typically cost about £7.00. If a loft pack is used, two wooden strips will need to be screwed across the three boards on the underside, as illustrated in Fig 4.

The question arises as to what material to make the backs and the guide panels from.

Many, if not most radios backs were made from 3.5mm thick 'millboard' - a sort of compressed cardboard which becomes fragile and brittle with years of exposure to heat from valves and mains droppers - hence the damage to the old back that we so often see. You can still get millboard from firms that supply car restoration materials but it's not cheap, nor do I think it's the best material to use with a router. (The holes would originally have been stamped out on a press using a punch and die arrangement).

3mm MDF could be used or standard 3mm hardboard, though 3mm oil tempered hardboard is a much better choice as it is more robust than both MDF or normal hardboard, though is not so easily sourced locally. Standard 3mm hardboard is rather 'fluffy', but will suffice and was used to make the six backs shown in this article, using the 'universal jig'.

Two 4ft x 2ft sheets are sufficient to make the jig and several backs. If oil tempered hardboard can't be found locally, then either

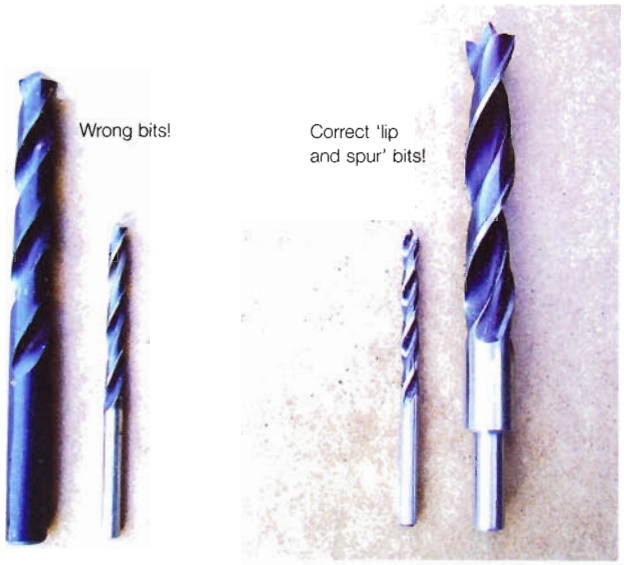

Fig 6: Use the correct type of wood bit for drilling holes in wood, MDF or hardboard

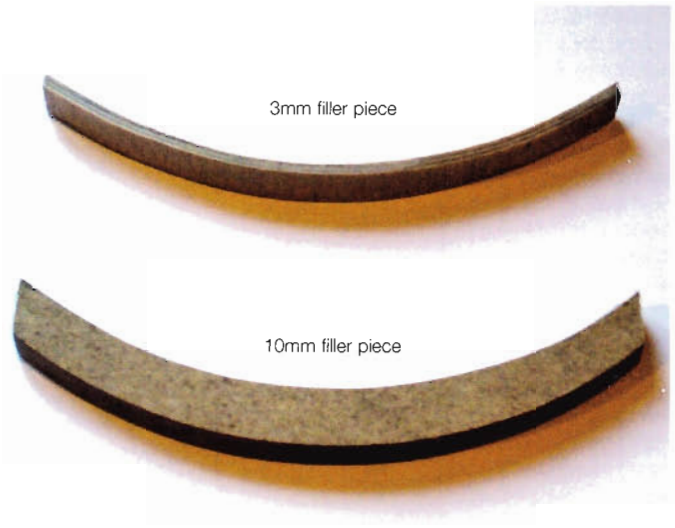

Fig 7: Sole plate guide 'filler pieces'

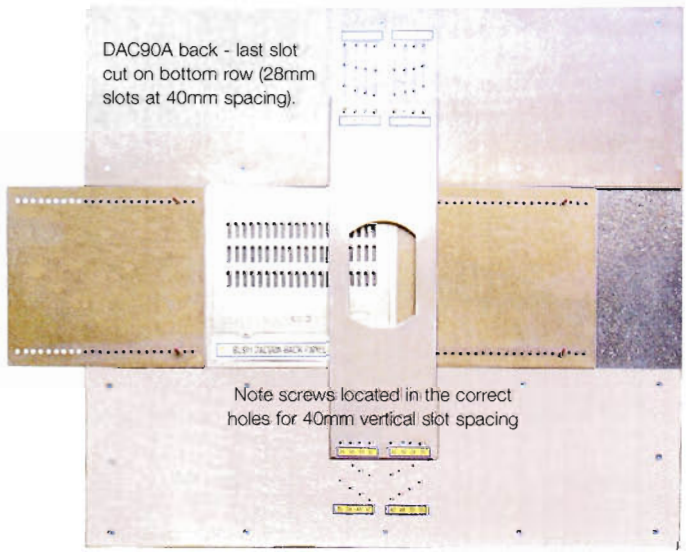

Fig 8: Jig with DAC90A blank in place

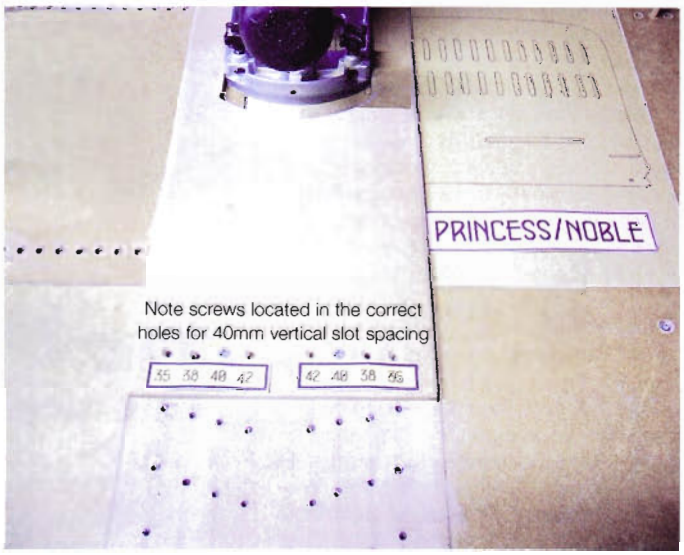

Fig 9: Princess Back showing 40mm screw spacing

3mm MDF or standard hardboard would suffice. At the time of writing, a 1.2 x 2.4 Metre (4ft x 8ft) sheet from B&Q costs less than £6.00 and in larger stores they'll cut it to your sizes free of charge while you wait. At less than 20p a square foot, there's lots of scope for making the jig, making mistakes, and making lots of backs too!

The same basic principles apply to making a slot-cutting jig for any radio back that has ventilation slots rather than holes. The width of slot seems to be standard at 6mm (1/4"), and the horizontal spacing in all of the radio backs that I have seen has uniformly been 12.5mm, (1/2"). However, the length of slots that I have encountered to date have been 28mm, 25 mm and 18mm, and vertical spacing from the top of one slot to the top of the slot beneath it has varied from 35mm, to 38mm, 40mm and 42mm. For the jig to be worthy of the name 'universal' it needs to cater for different lengths of slots and vertical spacings, and as designed, the jig will indeed cater for these variations. Fig 3 shows common dimensions that I've encountered, but they are by no means 'standard'.

If radios are encountered with larger dimensions that the jig can cater for, or different slot spacings, the same basic principles can be used to build a larger purpose-made jig for such radios. For example, the circular back of the Ekco A22 is just a little too large at 32.5cm diameter (12.75") to use the jig as it stands, but all that would be required to modify the jig to suit the A22 back panel would be to reposition the top and bottom fixed guide panels to enable a 32.5cm square panel (or a little larger to allow for some waste) to fit into the jig. The A22 panel has a row of 11 horizontal slots down each side, and 11 slots across the top, all 28mm long, spaced at 12.5mm centres. All three rows of slots could be cut on the jig by turning the square blank so that each row of slots is cut in the upright position along both sides and the top. The rest of the ventilation holes on the back panel of the A22 are 20mm diameter and could be quickly cut on a pillar drill using a 20mm 'lip and spur' drill bit. The square blank would then be trimmed to its circular shape on a band-saw or with a fretsaw.

If slots in particular radios are encountered which differ from the usual 12.5mm (1/2") horizontal spacing, all that would be needed would be for the two lateral guide panels to have their two rows of holes for the dowels to be positioned at the correct intervals. (There is no reason why additional rows of holes could not be made in the lateral guide panels for different horizontal spacings and alternative dowel positions to suit those additional rows of holes, rather than to make new guide panels).

Making and using the 'Universal Jig':
The Upper and Lower Fixed Guide Panels:
Two fixed guide panels are screwed to the baseboard above and below the back panel blank, such that the blank and the two lateral guide panels can move sideways between these two fixed guide panels to reposition the blank and the lateral guide panels for the cutting of each slot, but with no play between those panels. See fig 5

The Lateral Guide Panels:
For the slots to be spaced accurately between each other, two 'lateral guide panels' are made from the same material as the new back, each to fit either end of the blank back panel. These guide panels are held in position with two 6mm dowels for each end panel. By making the guide panels 33 cms long (13"), up to twenty-four 6mm (or ¼") diameter holes can be drilled in these panels at 12.5mm (1/2") intervals, which will enable up to 24

slots to be cut in a blank back panel up to 34.5cms (13.5") wide . Use a 'lip and spur' drill bit intended for woodwork to drill the holes – not a standard metalworking bit, which is hopeless for drilling accurate holes in hardboard or MDF. See fig 6 for drill types. (A set of seven 'lip and spur' bits will typically cost no more than £5.00). In making these two guide panels, they should be carefully marked out, temporarily taped together and accurately drilled together as a pair so that the holes of each panel match up exactly when held in place with the pairs of dowels on the jig.

The Router Sole Plate Guide:
The job of the router sole plate guide is to restrict the movement of a plunging router to that which is needed to cut the slot. The aperture in the sole plate guide allows the router to move up and down the 'Y' axis for 28mm, to cut a slot using a 6mm router bit. The router sole plate guide is made from an off-cut of 10mm or 15mm MDF, using a jigsaw to cut an aperture to the shape of the footprint of the router soleplate but 28mm longer than the soleplate - the length of the slots to be cut in the new back panel.

This aperture in the guide must be accurately cut so that there is no sideways play as the router moves up or down the soleplate guide. The greater the care in cutting this aperture, the greater will be the accuracy of the slots, so it's worth taking extra care over this.

To cut slots shorter than 28mm – for example, 25mm or 18mm, which I have encountered, a 3mm or 10mm 'filler piece' may be inserted into the aperture to limit the travel of the router by that extent. The 3mm filler piece can be made of layers of thick card glued together to the desired profile. (See Fig 7: filler pieces)

If the sole plate guide is made to the dimensions stated, and the top edge is set to 4cms from the top of the baseboard, it should be possible to cut up to six rows of slots in a blank panel ranging from 2cms from the top of the panel to the top of first row, to 5cms from the bottom of the panel to the bottom of the last row. This may vary according to the size and shape of the router sole-plate.

To drill the screw holes at intervals to enable vertical spacings of 35, 38, 40 and 42mm, it is only necessary to accurately mark the series of holes in the top fixed guide panel. Then fit screws into each pair of holes at the top of the router sole plate guide and use a small drill to drill pilot holes for the corresponding pair of screws in the bottom fixed guide panel. This simplifies the marking out and ensures that each set of four screw holes is accurately lined up.

Positioning the holes for the 6mm dowels on the jig:
With the router sole plate guide in place, insert a 30cms square blank back panel beneath the guide and position each lateral guide panel at either end of the back panel. Slide the three panels to the right until the first pair of holes of the LH panel are 16cms (6.25 inches) from the LH edge of the baseboard, and the first pair of holes of the RH panel are 20cms (7.75 inches) from the RH edge of the baseboard. Put the router in position with the bit lowered to just touch the blank panel. That should have set the first slot cutting position at 2.5cm (1 inch) from the LH edge of the blank panel. A 30cm wide blank will allow rows of 21 slots to be cut, (as needed in the Wartime Civilian Receiver for example), allowing for 2.5cms at either end. If a blank panel of 34cms (13 inches) is used, it would allow rows of 24 slots to be cut, allowing for 2.5cms at either end of the panel. In that case, the holes in the baseboard for the two dowels for the LH guide panel will still need to be 16 cms from the LH edge of the baseboard, and the RH dowel holes will also need to be 16 cms from the RH edge. This isn't as complicated as it may sound! With the blank back panel and the two guide

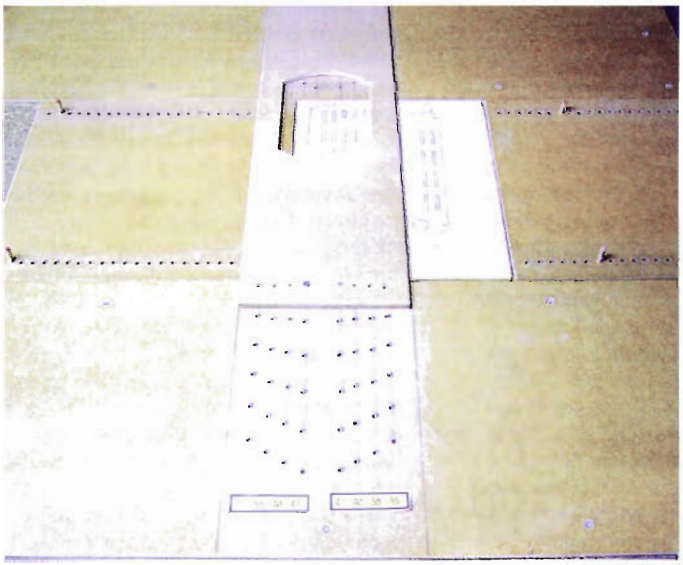

Fig 10: Murphy U198 showing back on end to cut slots, and 42mm slot spacing

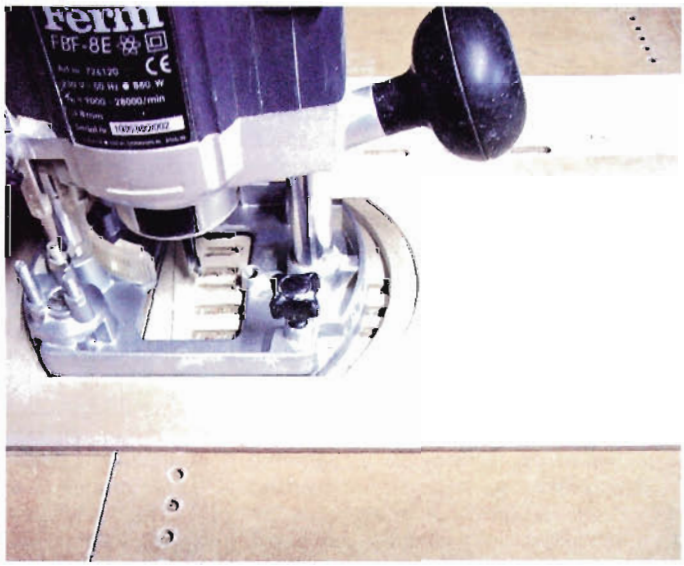

Fig 11: 10mm Filler Piece in place to cut shorter slots (18mm)

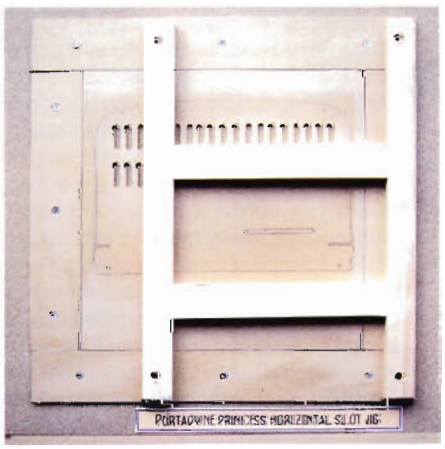

Fig 12: Portadyne horizontal slot jig step 1

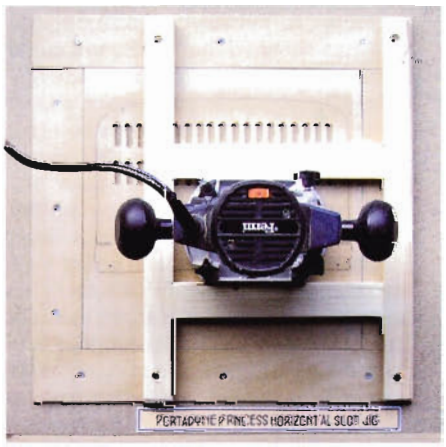

Fig 13: Portadyne horizontal slot jig step 2

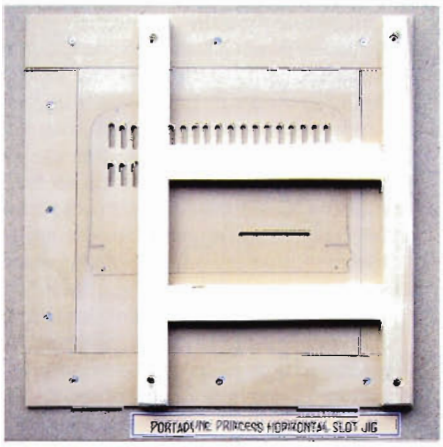

Fig 14: Portadyne horizontal slot jig step 3

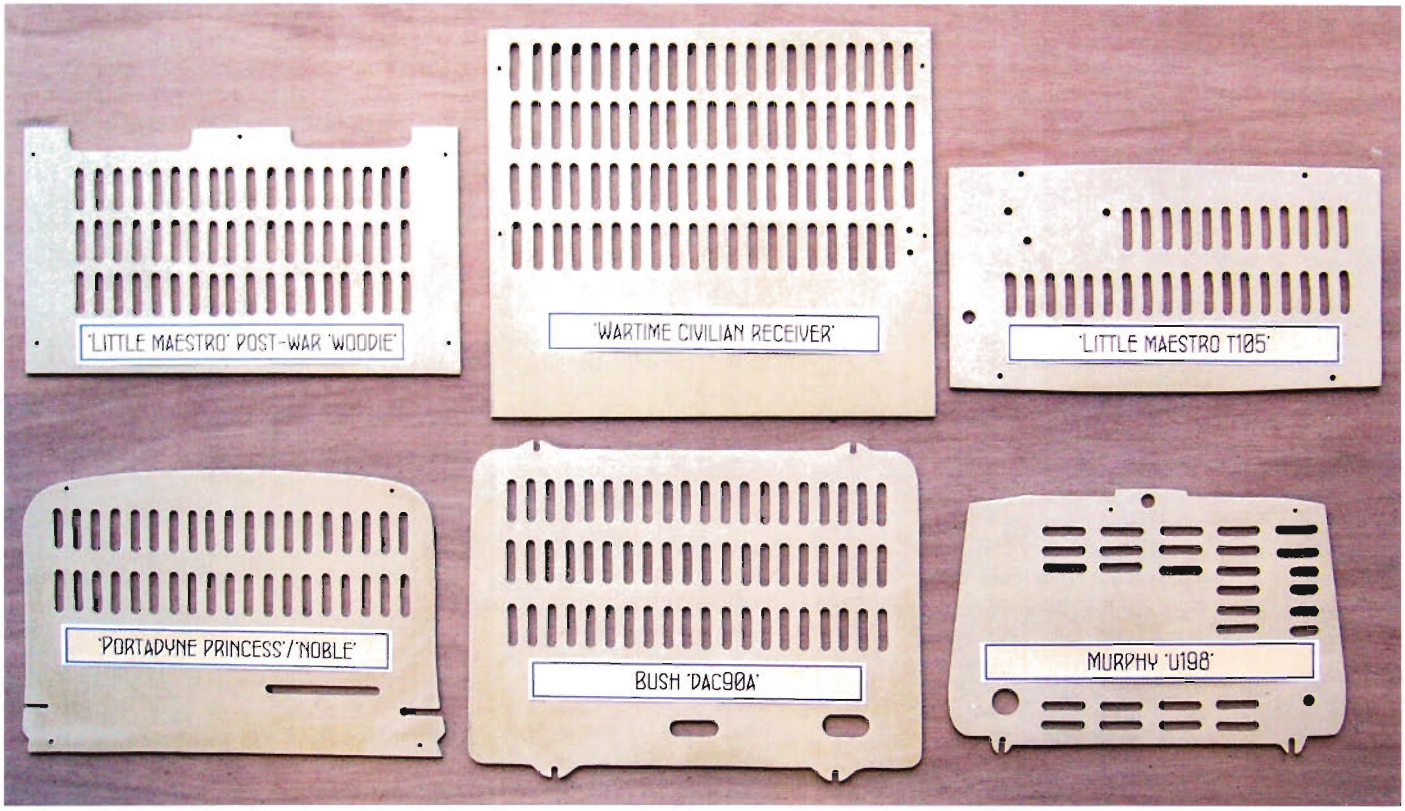

Fig 15: Backs ready for painting and labels.

panels in place, it becomes self evident where the dowel holes need to be drilled.

If all is well, drill 6mm holes in the baseboard through the far LH pair of holes of each lateral guide panel for the dowels to fit into. In use, the dowels need to be just loose enough to be easily removed and refitted with the fingers so as to move the guide panels and refit the dowels in their holes as each new slot is cut.

In use, as each slot in a row has been cut, these two lateral guide panels, along with the new back panel, are moved to the left (beneath the fixed router sole plate guide) one hole at a time on the dowels until all the slots in the first row have been cut. The sole plate guide is then repositioned lower down at the desired distance (from 35 - 42mm) for the particular panel being made, to enable the next row of slots to be cut, and the process repeated for any further rows of slots.

Positioning the router sole plate guide, lateral guide panels, and back panel blank:

To set up the jig, with the router switched off and unplugged, the router bit is lowered so as to just touch the blank, and locked at that depth. The router is placed in the sole plate guide with the router bit at the top of the first slot position on the blank. Mark the position of the router bit on the blank panel with pencil, then remove the blank and use that pencilled position as a reference point to draw the position of all the slots on the blank, to ensure that the slots will be correctly positioned where you want them on the blank. Ideally, the complete pattern of the slots should be marked on the blank (perhaps using an old damaged back or one borrowed from another set as a template), so that slots are only cut in the correct positions on the blank. Because the jig can cater for up to 24 slots, it's all too easy to inadvertently cut too many slots if fewer than 24 slots are needed, as will mostly be the case. This is especially important with back panels that have oddly spaced slots of different sizes, as is so with the Murphy U198 for example.

The sole plate guide is then screwed to the baseboard in a position which will enable the blank back panel and the two lateral guide panels to be progressively moved sideways along the 'X' axis beneath the sole plate guide to cut the first row of slots. Still with the router unplugged and the bit lowered, move the router up and down the sole plate guide to satisfy yourself that the guide is accurately positioned over the blank to cut the first slot where you want it. Then place the two lateral guide panels either side of the blank back panel, with the two dowels in each panel pushed through the appropriate holes in the guide panels.

When satisfied that the lateral guide panels and router sole plate guide are correctly aligned to cut the first row of slots, unlock the router bit so you can plunge the router downwards, and set the depth stop on the router so as to just cut through the blank, but not into the baseboard. Plug in the router, position it at the top of the sole plate guide, switch on, plunge the router into the blank and pull the router towards you to the end of the guide to cut the first slot, and then allow the bit to retract and switch off the router. When the router has stopped, put it aside and reposition the blank by moving it and the two lateral guide panels one place to the left on the pairs of dowels.

Repeat this process until the entire first row of slots has been cut. To cut a slot and reposition the guide panels to cut the next slot takes no more than thirty seconds, so once the jig is set up, to cut a row of 20 slots should take about ten minutes.

To cut the next row of slots, reposition the router sole plate guide lower down on the baseboard in the correct screw-holes for the vertical spacing, from 35mm to 42 mm, as called for by the particular back., and screw the sole plate guide into position, repeating the procedure used for cutting the first row of slots, then do the same again for any further rows of slots as called for. This process will become clearer by reference to the pictures. Fig 8 shows the completed jig with all the components labelled and the last slot cut in a DAC90A back panel.

The pictures show how the work progresses, with the first hole in the top row being cut, proceeding until the whole back panel has been cut. It will be evident how the two lateral guide panels of the jig are moved progressively to the left, with the next pair of holes in each of these lateral panels of the jig held in position by the two dowels so that the vertical slots can be cut, while the back panel blank is prevented from any sideways movement by the two lateral guide panels. Note the rows of screw holes in the baseboard to enable the router sole plate guide to be moved down and re-secured further down the board at desired intervals from 35mm - 42mm for each successive row of slots to be cut. Fig 9 shows the screws in place on the Sole Plate Guide for the 40mm spacing of slots in the Portadyne Princess.

Two other slots that needed to be cut

Fig 16: Backs painted and labelled

along the top of my Little Maestro panel were quickly cut on a bandsaw. Holes were drilled for the back to be screwed onto the radio, and a hole for the mains flex. If an odd shaped back is called for (circular, sloping sides, curved top etc), as was the case with the Murphy U198, Bush DAC90A and Portadyne Princess sets, the blank must start out rectangular and slightly oversized, then when all the slots have been routed out, the board is cut to the desired shape using a cardboard template of the shape of the back panel in question.

Occasionally backs may have horizontal slots and slots of more than one length - the Murphy 'U198' for example has both 28mm and 18mm slots. In that case, a 10mm 'filler piece' will need to be put into the aperture in the router sole plate guide when the shorter slots are cut, to limit the travel of the router to cut those shorter slots.

Cutting horizontal slots:

As the slots in the Murphy U198 panel are horizontal, the blank panel was placed on its end in the jig so that the slots could be cut from top to bottom in the router guide. In effect, the back is cut 'portrait' fashion rather than 'landscape' as shown in fig 10. The shorter (18mm) slots are cut with the 10mm 'filler piece' in place in the sole plate guide. Fig 11 should make this clear. (For the longer slots the 'filler piece' is removed).

After the slots have been cut, the blank will need to be shaped either on a band-saw or with a fretsaw, and several holes drilled for such things as the wave-change switch, mains lead and mounting holes, but the router takes care of the tricky stuff!

Cutting other slots:

Occasionally it will be necessary to cut additional slots of odd lengths in positions not catered for by the jig. This was the case with the Portadyne Princess and Noble receivers, in which a 75mm horizontal slot was needed beneath the vertical ones, so a simple horizontal guide was made for that, and is shown in figures 12, 13 & 14. The new back panel was held in place on a baseboard by strips of hardboard and the position of the slot was marked on the new back panel. With the router positioned at one end of where the slot is to be cut, strips of wood were then screwed to the baseboard to guide the router and to limit the travel of to allow the 75mm slot to be cut.

Finishing touches - painting and labelling the panels:

Most panels are dark brown, so to paint the backs I've made to date I've used 'tester pots' of brown matt emulsion paint from a DIY store. Homebase 'Double Espresso' or Wilko 'Java Bean' are a reasonable match, and will be enough to give two coats to two or three small back panels. When painted, I've then created and printed labels as close to what the original labels consisted of, sprayed with clear lacquer to make them waterproof and fixed them with wallpaper 'border paste'.

In some instances labels were made from scans of actual backs – in others, I've designed a label by choosing a font as close to the original wording. In the case of the Wartime Civilian Receiver, I aged some paper by soaking it momentarily in strong black coffee, then ironing it dry between two sheets of kitchen roll. Figs 15 and 16 show six completed backs before and after painting and labelling.

Safety precautions:

It must be stressed that working with a router poses several hazards for which precautions must be taken if accidents are to be prevented. The router bit revolves at about 30,000 RPM, and the router must be switched off after each slot is cut, and the bit fully retracted and at a standstill before placing it down ready for positioning in the guide for the next slot to be cut.

Routers are very noisy, and MDF produces hazardous dust, so it makes sense to wear ear defenders, goggles and a dust mask. The term 'dust mask' does not include the disposable 'nuisance dust' white paper masks, whose only purpose is to fool one's loved ones into believing that we are taking sensible precautions. These masks fall far short of what is required when working with MDF or when wood turning. Face masks for working with MDF should be to P2 standard, and are widely available. Don't use your lungs as a dust filter!

I am indebted to fellow members of the Golborne Vintage Radio Forum for their encouragement, helpful suggestions and assistance with making the labels for replica backs. Notably, Tony Thompson for the excellent artwork for the Wartime Civilian Receiver back label, and Joe Freeman, Gary Tempest, Colin Wood and Robert Darwent. I am also indebted to Howard Craven who provided pictures of his Portadyne 'Princess', including the wording on the back panel, enabling me to make a back for my 'Princess' and later, for a 'Noble' TRF, which uses an identical cabinet to the 'Princess'.

I regret that I am unable to make backs or jigs on request due to time constraints, and it would of course make no economic sense to do so, but I do hope these notes provide enough information to inspire others to have a go themselves.