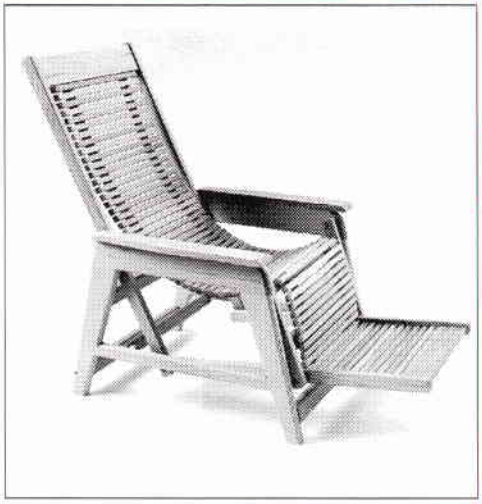
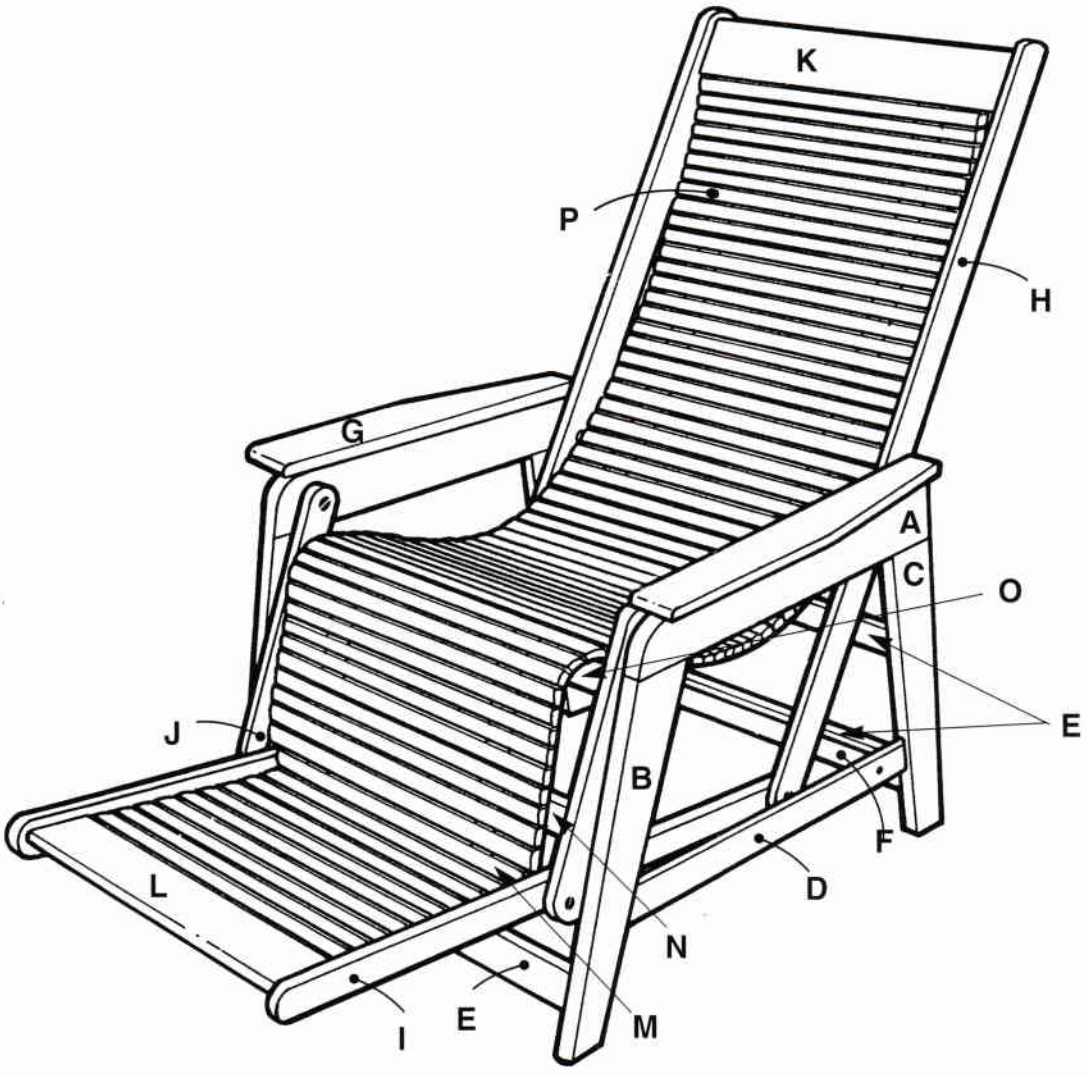
ADVANCED
PROJECT NO. 7



Reclining Verandah Chair

Far more attractive than the common types of banana lounges, a pair of these chairs would grace any verandah. The shape is reminiscent of the traditional squatter's chair, while the sophisticated pivoting seat frame is far more comfortable to use.

Both mortice and tenon and dowel joints are used in the construction, and the appearance is greatly enhanced by beading all exposed edges with an appropriate router bit. A Taper Ripping Jig (see Jig Guide for details) is required to make the legs and armrests.



Tool Requirements

1. ESSENTIAL Triton Workcentre and your power saw; Triton Router and Jigsaw Table and your router; router bits as follows: 12mm straight bit; beading bit; rounding-over bit; Electric drill; dowelling jig and Triton Woodbits or dowelling bits to suit; large drill bit to suit outer diameter of threaded rod couplers - see material shopping list; countersink; Triton Sanding Disc; bar or pipe clamps; G-clamps; small handsaw; hand plane; hacksaw; screwdriver; spanner for pivot nuts; measuring tape; square; pencil; orbital sander and/or sandpaper.

2. USEFUL Extra clamps; Triton Roller Support Stand.

Issue No. 1, December 1991

Construction Details

Component Specifications

All dimensions are in mm.

Part	Description	Quantity	Width	Thickness	Length
A	Leg Frame Top	2	92	32	600
B	Front Leg	2	92	32	476
C	Rear Leg	2	92	32	476
D	Leg Brace	2	42	32	608
E	Cross Brace	3	60	32	626
F	Backstop	1	42	25	586
G	Armrest	2	75	19	575
H	Seat Back Rail	2	42	25	1050
I	Seat Bottom Rail	2	42	25	860
J	Seat Hanger	2	42	25	380
K*	Headrest	1	92	32	534
L*	Footrest	1	92	19	464
M*	Rail Crosspiece	1	42	25	464
N*	Hanger Crosspiece	1	42	25	534
O*	Cross Dowel	1	32 dia. round x		510
P*	Slats	65	19	12	480
Q	Webbing	2	50	5	1500

** Do not pre-cut. Check for length after assembly of leg frames.*

General Points

1. The chair is dependent for strength and durability on good, well-fitting joints in the side frames and crossbar tenons.

The width dimension of the complete pivoting seat frame assembly may vary slightly, according to the type of nuts and washers used. It is best to construct the complete leg frame assembly first, and then adjust the length of components **K,L,M,N,O and P** if necessary.

2. The location of the pivoting points gives the chair that suits most people of average build. If you wish to change these locations, it would be wise the experiment first with an inexpensive timber, such as pine, to ensure that the movement operates satisfactorily.

With the Workcentre in the crosscut mode, set the protractor to 13 degrees and cut the material for components **(A, B, and C)** to length. Note that the cuts at the top and bottom of the legs **(B)** and **(C)** are parallel, whilst those on the ends of **(A and D)** converge. Reset the protractor to 18 degrees and cut components **(D)** to length.

Material Shopping List

1.WOOD A strong hardwood is appropriate for this type of chair. Jarrah would make a very impressive piece for furniture; we used kiln-dried Victorian Ash, with a stained finish. If another type of timber is chosen, the dowel component **(O)** would need to be stained to match. Note that we have assumed the slats will be ripped from 92mm wide material; if you are able to purchase a suitable flat moulding, adjust the quantities accordingly.

Shop for:

KD hardwood, DAR or Jarrah, clear Oregon, etc.

92 x 32mm 2 @ 2.4m
92 x 19mm 6 @ 1.5m
60 x 32mm 1 @ 2.1m
42 x 32mm 1 @ 1.5m
42 x 25mm 2 @ 2.1m, 1 @ 2.4m
32mm round dowel 1 @ 0.6m

2. FASTENING

Countersunk 40 - 50mm long 'harpoon bolts' or 'director screws' (both are normally sold as particle board fasteners) are used where tenons would be awkward, such as for the dowel component **(O)** and the angled backstop **(F)**. Four bolts or screws are required.

The tenons are fixed with a strong glue. We used Selleys 308 resin glue - epoxy or resorcinol would also be suitable.

A small amount of epoxy glue is required to fix the metal pivots into the chair components.

The webbing is attached to the slats with a large number of small screws (12mm x 4g) - preferably Phillips head or Posi-drive self-tapping type. It is probably most economical to purchase a box of 200, plus a pack of 50.

8mm dowels are used for the assembly of the leg frames and armrests. 20 dowels will be required, and they should be fluted or grooved. The webbing is held in the headrest with 6 small dowels, 6mm in diameter.

3. OTHER

The seat assembly pivots are 9.5mm dia. countersunk machine thread bolts, pivoting in female threaded fittings. These latter fittings are actually threaded-rod couplers, available from engineering supply outlets, and resemble a nut about 25mm long. You may also have to obtain the bolts from an engineering supply outlet.

Shop for:

8 countersunk head machine bolts, if possible brass or zinc plated, 9.5mm dia. x 50mm long, or the Imperial equivalent of 3/8" Whitworth x 2" long. Also obtain 8 nuts and 16 washers to suit.

8 threaded-rod couplers of the same thread diameter and type are also required; these may be either round or hexagonal in cross section. You may find you can only buy 50mm couplers...buy four and hacksaw them in half.

A total of 3.0 metres of strong webbing is required for the seat supports **(Q)**. Although nylon seat-belt webbing or its equivalent would be suitable, we used a common industrial belting material 50mm wide and 5mm thick, made of rubberised canvas. The extra thickness allowed the fixing screw heads to countersink themselves neatly into the webbing.

4 rubber stops, such as small door stops or toilet seat bump rubbers are required to buffer the pivoting seat frame at the extremes of its travel.

4. FINISHING

Suitable finishes for such a chair are polyurethane varnish, or Danish Oil, whether alone or combined with a suitable stain. It is best to fine-sand all components before assembly.

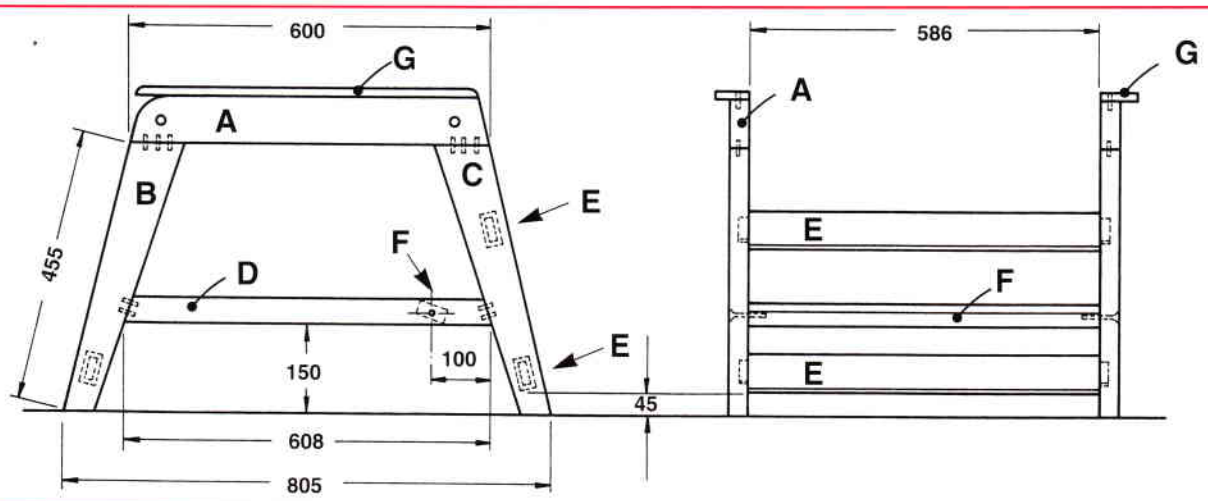


FIGURE 1: LEG FRAME ASSEMBLY

Then fit the workstops and cut components **(E and F)**, and the armrests **(G)** (from 92 x 19mm material). See **Figure 1**.

2 The legs are tapered using a taper ripping jig. Mark the taper on one of the legs as shown in **Figure 2** and set the jig to the line. Rip one side of each of the four legs, and set them aside in two pairs, **(B and C)**. **Figure 3** shows the procedure.

Similarly use the jig to make a taper on one side of the rear of each armrest **(G)**, as shown in **Figure 2**, for improved appearance.

3 Mark out the positions of the mortices on the front and rear pairs of legs, as shown in **Figure 2**, measuring from the 455mm long side of the legs in each case. Note that the mortices in each pair of legs are mirror imaged.

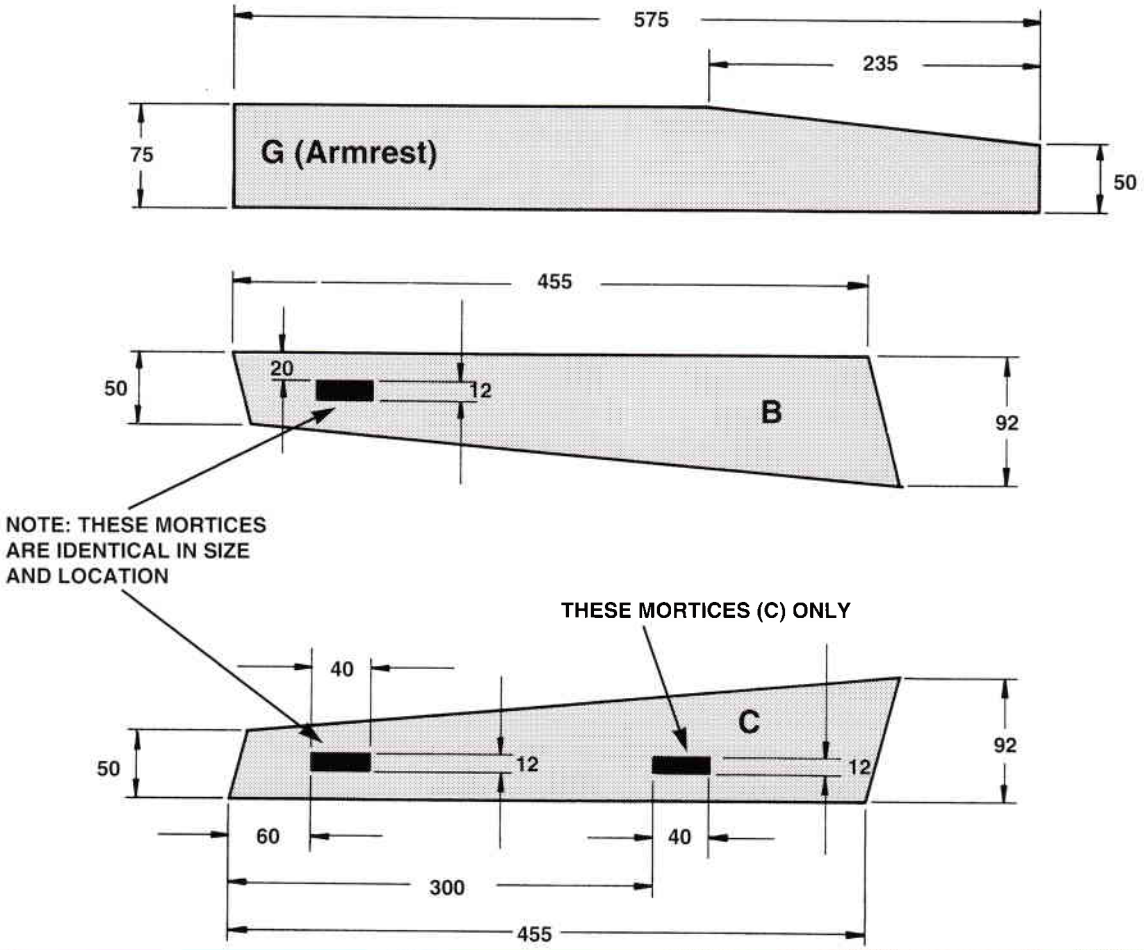


FIGURE 2

Construction Details

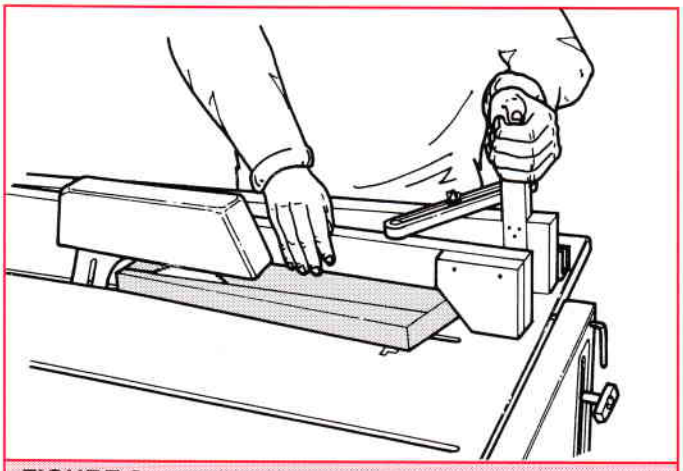


FIGURE 3

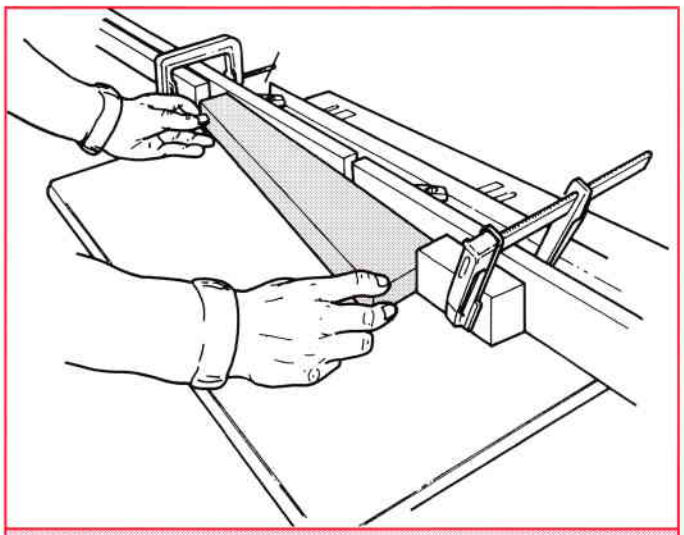


FIGURE 4

4 Set up the router in the shaper mode, and using a 12mm straight bit carefully make 21mm deep and 40mm long mortices in **(B)** and **(C)** to suit the tenons, working between stop blocks with the 455mm side of the workpiece against the fence. If your straight router cutter does not have an end-boring insert remove the full depth of the mortice in a series of shallow cuts. **Figure 4** shows the procedure.

5 With the rip fence set to 17mm (allowing for a 3mm saw kerf) and the saw blade height at 10mm, make 20mm long x 12mm wide tenons on each end of the crossbars **(E)** as shown in **Figure 5** to suit the mortices.

Round the ends of the tenons, or chisel the ends of the mortices square if you prefer, and test-fit the legs and crossbars together. Mark the components for identification and disassemble.

(Note that component **(F)** will be fixed into place with director screws and so doesn't require tenons.)

6 The next step is to trial assemble the individual leg frames. Lay components **(A, B and C)** of each side down in their fitted positions and mark the components according to the instructions with your particular dowelling jig. We fitted three dowels in the end of each leg, using the versatile and accurate Marples M148 dowelling jig.

Use a Triton Woodbit or a dowelling bit to drill the mating faces of both components, slightly deeper than half the length of the dowels.

For the next step of trial assembly it may be easier if the flutes are sanded off some spare dowels to slightly reduce their diameter and make for easier fitting.

7 Test-fit components **(A, B and C)** of each side together and lay the assemblies on a flat workbench. Slide the leg brace **(D)** up between the legs until it just fits snugly without forcing the legs apart. Check that the meeting faces at the tops of the legs are still snugly together then mark the positions of the dowels on the side faces at the ends of **(D)**. Note that the dowels are square to the angled faces. **(Figure 1)**

Two dowels are fitted in each end of **(D)**. Mark and drill for the dowels as before, staggering the dowel holes slightly to reduce the risk of splitting.

8 The two leg frames are now assembled. First fit the leg brace **(D)** with glue and dowels, then glue and dowel the top component **(A)** in position, using a strong glue. You may need to tap component **(A)** into place with a hammer and block of wood, with the leg assembly standing upright on the workbench.

Apply the first clamp across leg brace **(D)**, using wedges outside the legs to give a square face for the clamp jaws; the tapered offcuts from the legs can be cut up and used as wedges.

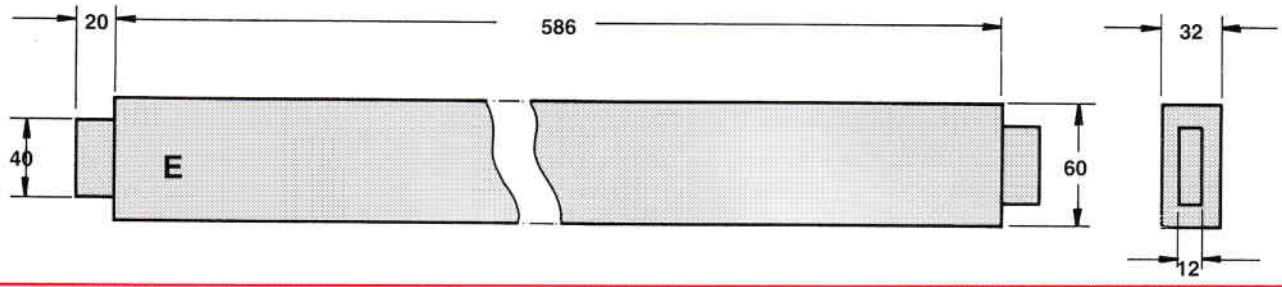


FIGURE 5

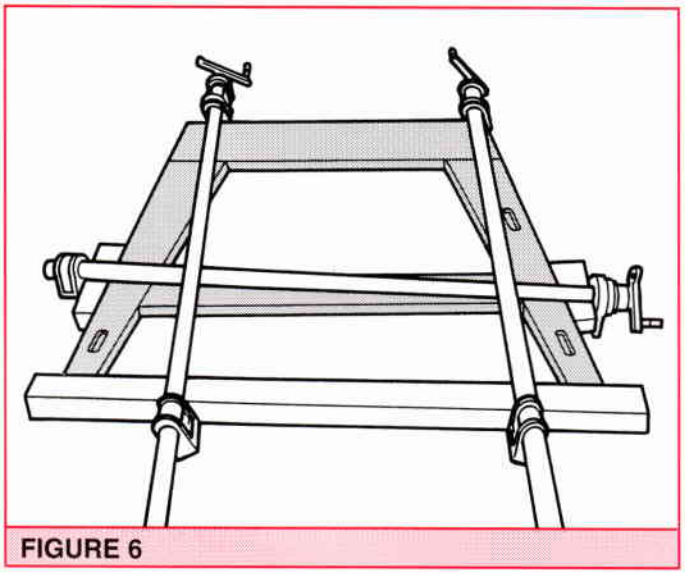


FIGURE 6

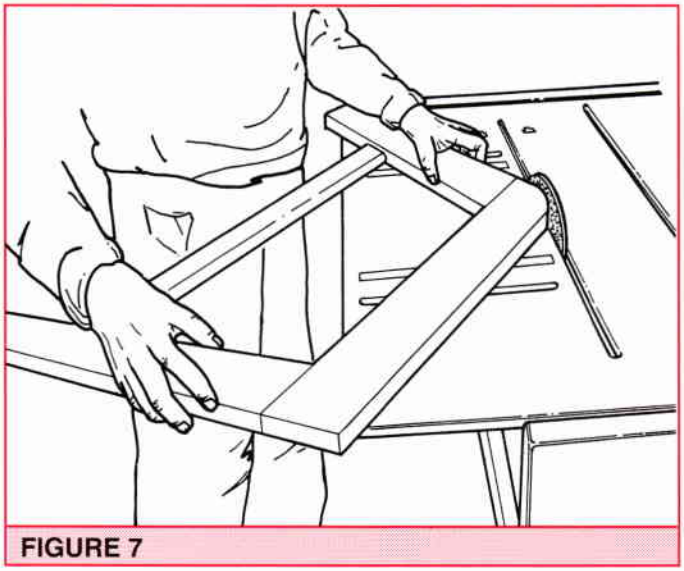


FIGURE 7

When the leg brace joints have closed satisfactorily, apply two more clamps from top to bottom of the assembly to close the upper joints, using a scrap length of wood across the leg bottoms to take the jaws of the clamps. **(Figure 6)** When dry, remove excess glue and finish-sand the assemblies.

9 Using your Sanding Disc round the upper front corner of each leg frame **(Figure 7)**. Also round the top arris of the front and rear of the arm-rests **(G)** as shown in **Figure 1**, holding the armrest on its 19mm edge on the worktable while sanding. Remember when rounding the ends that the armrests are mirror imaged.

10 For an improved appearance fit your beading bit to your router and bead all edges of the assemblies except the upper-most edges of **(A)** which will be in contact with the armrest. (And of course don't bead the bottom "feet" edges of **(B)** and **(C)**). Also finish all the long edge of the crossbraces **(E)** with the beading cutter and all long edges of the backstop **(F)**. **Figure 8** shows the procedure. Note the Extension Table used to provide additional workpiece support.

11 Mark and drill the holes for the threaded-rod couplers in components **(A)**, 50mm in from each end, and on the centreline of the

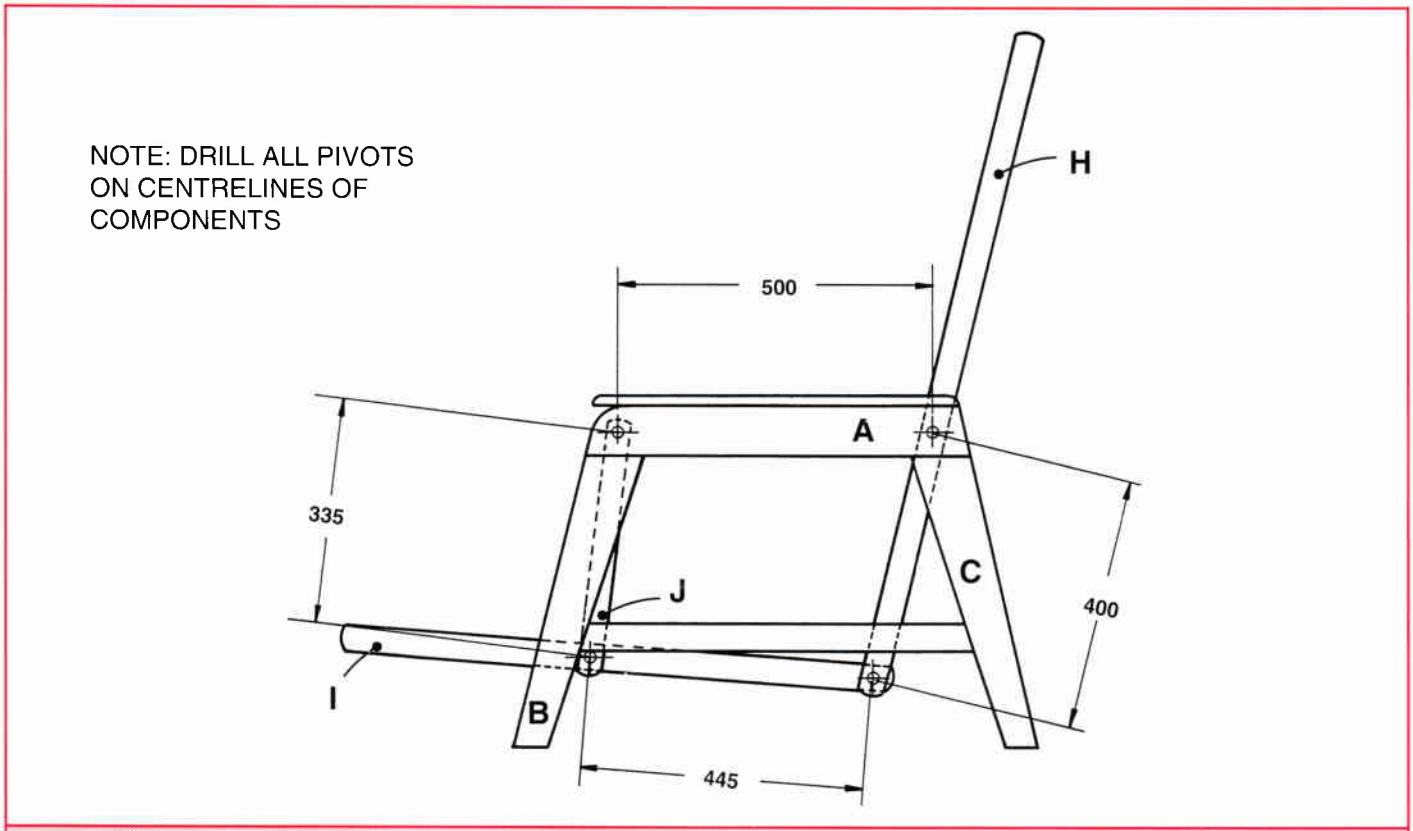


FIGURE 9: PIVOT POINTS

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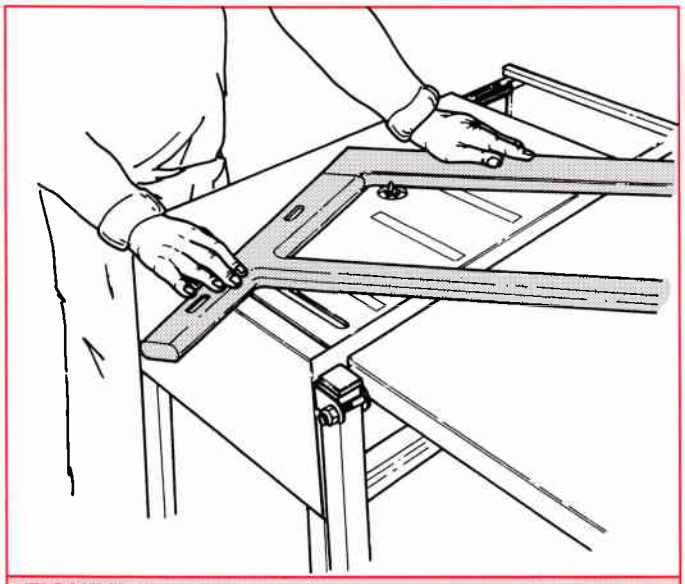

FIGURE 8

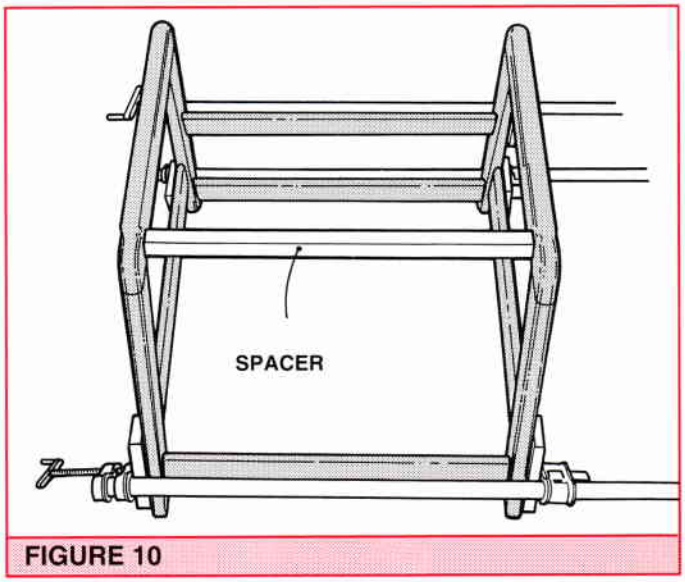

FIGURE 10

components, as shown in **Figure 9**. Be careful to drill from the inside face in each case, and to use a depth stop to avoid breaking through the outer face. A light push fit of the couplers in the holes is ideal; they are secured in place with a smear of epoxy glue on their outside diameters.

If your brand of coupler is hexagonal in cross-section, drill a hole slightly smaller than the diameter across the "points" of the hexagon, and tap the coupler into position. Fill the space around the outside with epoxy glue, taking care not to contaminate the threads.

12 The leg frame assemblies are joined by gluing in place the crossbars **(E)**. If you have sanded or machined off your identifying marks, double-check the positions of the tenons for the best fit, then coat with a resin glue and assemble

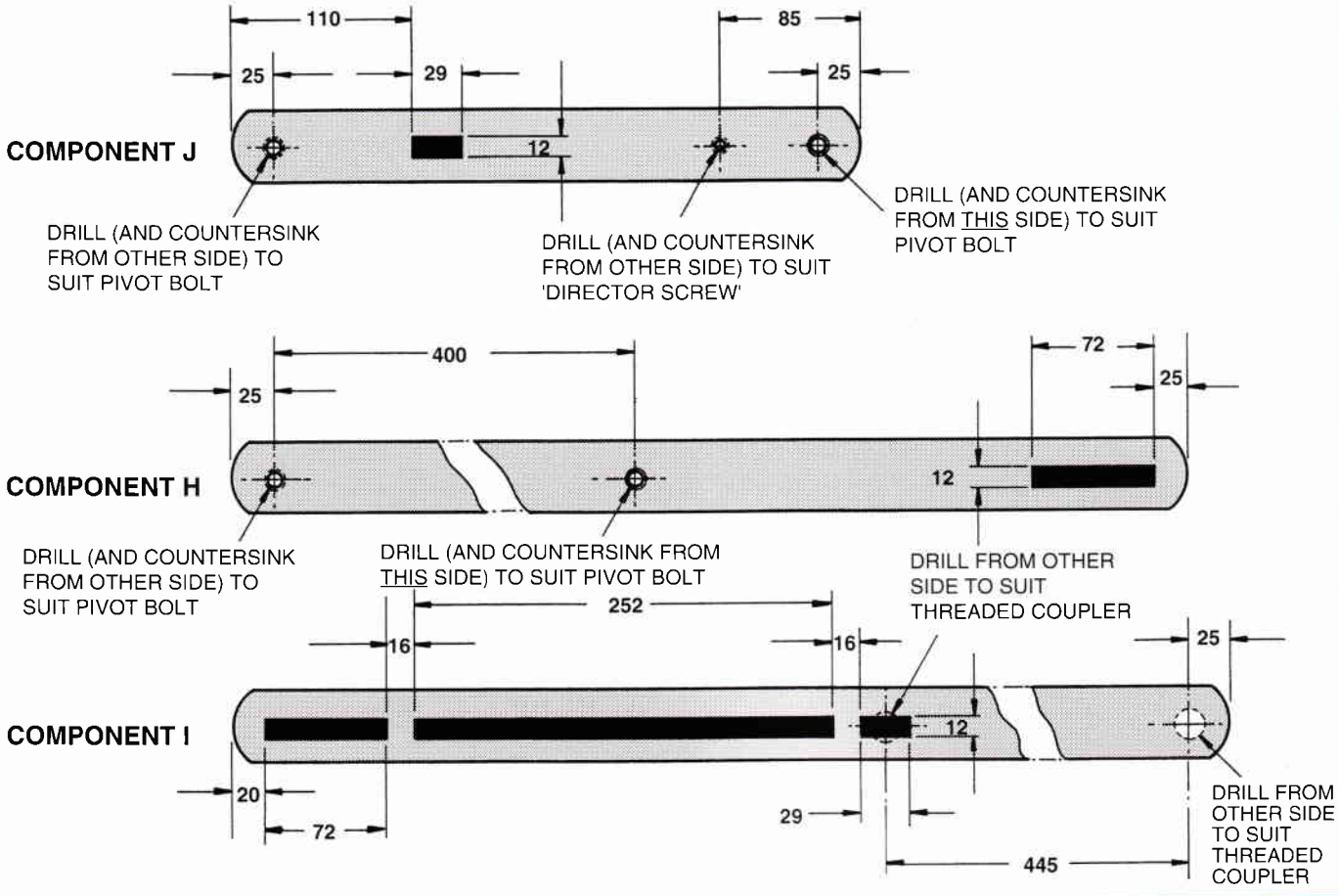

FIGURE 11

with pipe or bar clamps as shown in **Figure 10**. Note the use of dummy cross-bar cut to 586mm as a spacer at the upper front of the assembly; component **(F)** can be used temporarily if desired.

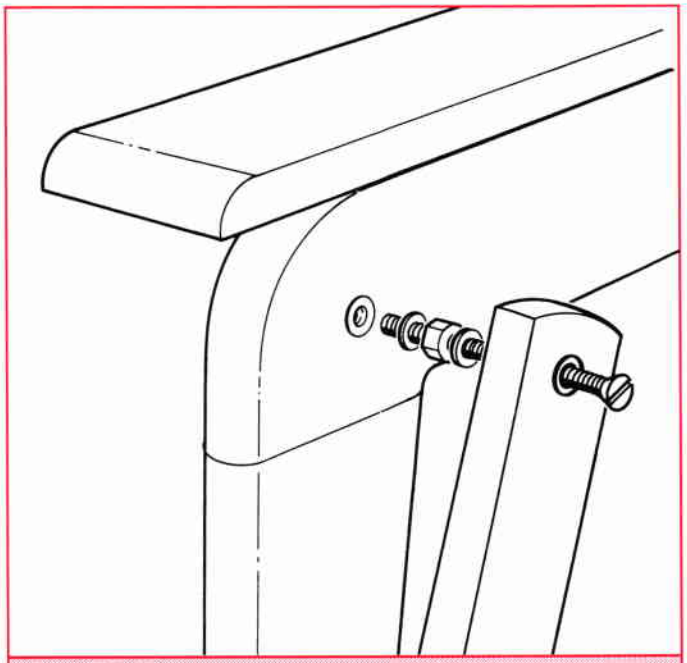

FIGURE 13

13 The base assembly is completed by gluing and dowelling in place the armrests **(G)**. Use three equally spaced dowels, which you may wish to shorten to about 25mm, and be careful to reference your dowelling jig from the inner (straight) edges of the armrests. (The armrests are fitted with their straight edges aligned with the inner faces of components **(A)**). It is best to clamp the armrests in position while marking the dowel positions, and also after gluing.

After cleaning up excess glue and fine-sanding as required, the base assembly can be stained and finished. The backstop **(F)** is fitted later, as its position is a matter of personal preference.

14 Cut components **(H, I and J)** for the pivoting seat frame to length, and mark out as shown in **Figure 11**. A study of **Figure 12** is also useful as an indicator of pivot and component locations. Round the ends with your Sanding Disc, and round over the long edges with a rounding over bit. Drill the holes for the pivot bolts, and for the fixings for the cross dowel **(O)**, noting carefully the positions of the countersinking.

Also drill the holes for the threaded-rod couplers where indicated in components **(I)**. You may wish to shorten the couplers with a hacksaw if you do not wish to drill holes right through the components, which are thinner than components **(A)**. In this case, ensure that you drill the stopped holes from the opposite sides to the mortice positions, as indicated in **Figure 11**.

Note that the more central coupler hole coincides with the centre of the mortice for component **(M)**. This hole will need to be opened out again with a hand-held drill after assembly has been glued together, to remove that portion of the tenon which obstructs the hole.

15 Make 13mm deep mortices in **(I, J and H)**, with the locations and dimensions as shown in **Figure 11**. The easiest way to make the mortices in the long components is to mark with pencil on your router table the front and rear extremities of your cutter, and transfer the start and finish lines for your mortices to the side faces of your components, using a square and pencil.

Set the router fence so that the mortice will be central, and use the pencil marks on the table as a guide when plunging the workpiece on to the bit at the beginning of the mortice, and lifting it off at the end. Take out the full depth of the mortices in two or three shallow cuts.

FIGURE 12

Construction Details

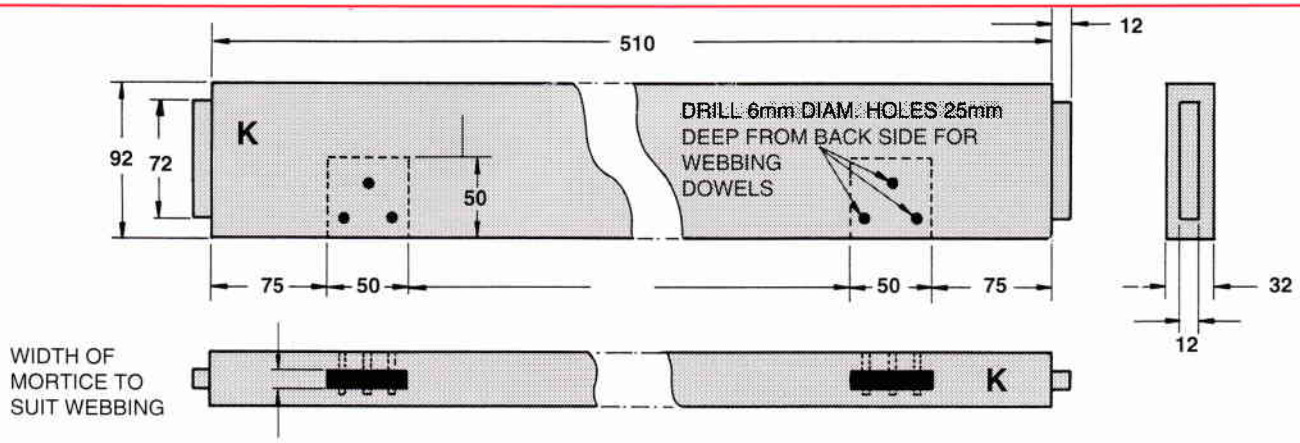

FIGURE 14

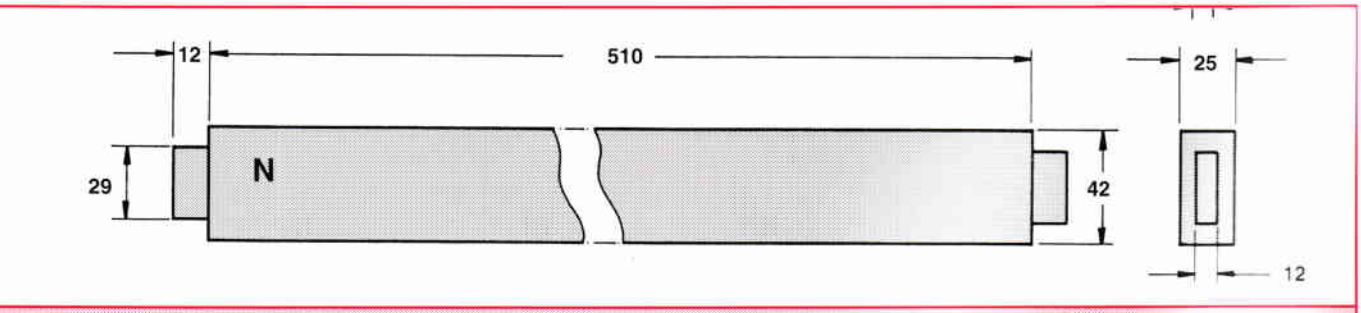

FIGURE 15

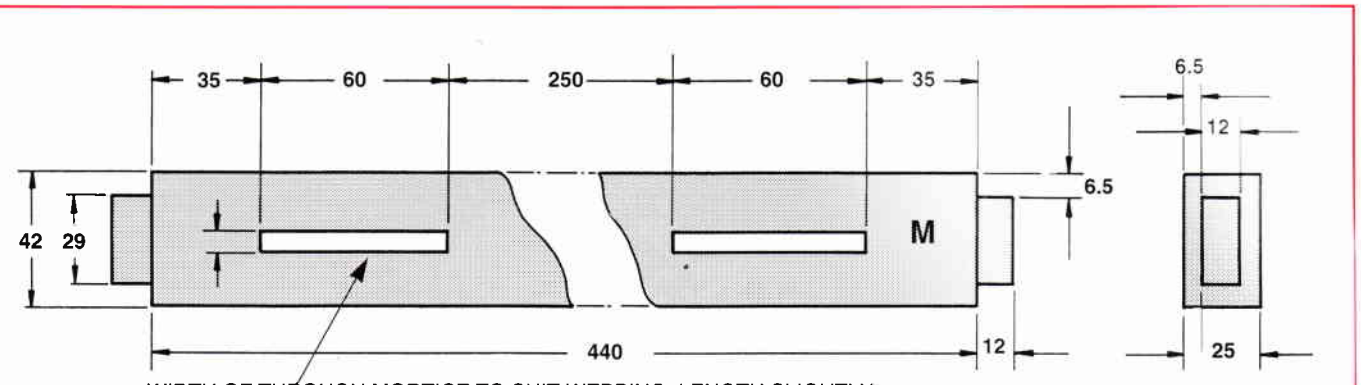

FIGURE 16

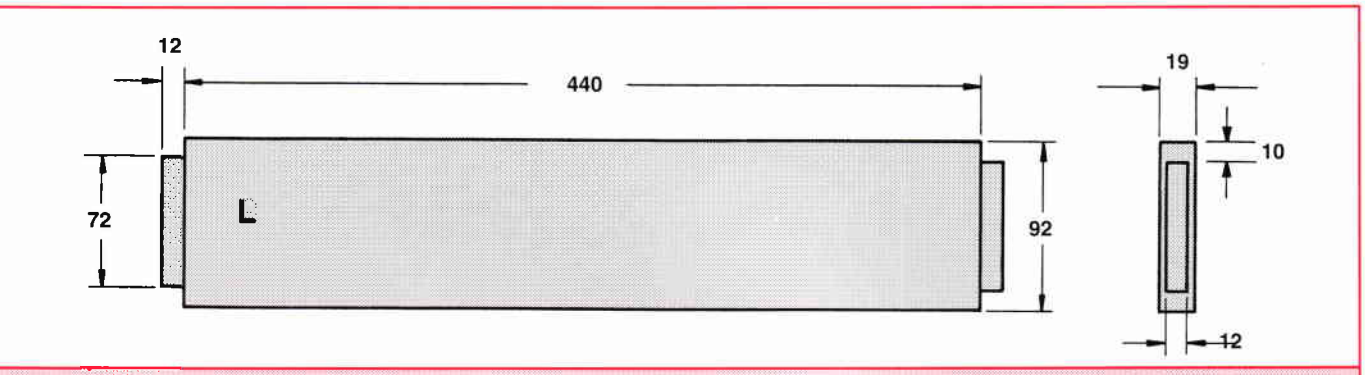

FIGURE 17

16 The next step is to determine the exact lengths of the cross rails: headrest **(K)**, hanger crosspiece **(N)**, and cross dowel **(O)**. Insert one countersunk pivot bolt through the middle hole of each of the back rails **(H)** and another countersunk pivot bolt through the uppermost holes of the hangers **(J)**, add a washer and a nut (finger tight).

Add another spacing washer and screw the rails and hangers into position on the leg frame assembly, tightening the screws into the female threaded couplings in **(A)** until the components pivot freely without side play. Tighten the nuts against the back rails and hangers, to prevent the bolts rotating in the wood. **Figure 13** shows a typical assembly.

Measure the distance between the inside faces of the components; this is the length of the dowel component **(O)** (should be 510mm). Add 24mm for the tenons to obtain the length of components **(K)** and **(N)** (should be 534mm). Cut **(K, N and O)** to length.

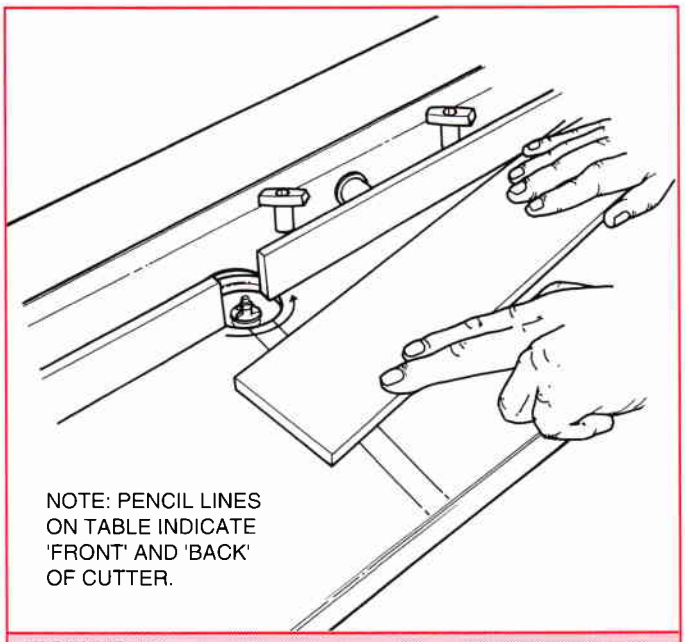

FIGURE 19

17 Deep mortices must now be made in the lower edge of **(K)** to house the webbing, as shown in **Figure 14**.

The best way to accomplish this is to drill deeply a series of overlapping holes with a Triton Woodbit, and remove the remaining material with a thin chisel. In our case the 5mm thick belting material we used made this relatively easy; if you are using thinner webbing it may be best to make the narrowest mortice you can, and wedge the webbing in position with the top folded over a thin strip of wood, together with the glue and dowels.

18 Set the table saw fence to 9mm and the saw-blade height to 10mm and make the tenons on component **(K) (Figure 14)**. Reset the blade height to 6.5mm to make the tenons on component **(N) (Figure 15)**. Remove the rails from the base assembly and check the fit of the components. Bead the upper edge of the headrest **(K)** if desired with your beading cutter, then finish-sand the components.

Using a resin glue, fix **(K)** into position using clamps and a dummy crosspiece (component **(O)** can be used) to space the rails. Ensure that the rails are in the same plane while the glue sets.

In a similar manner, fit component **(N)** into the seat hangers **(J)**, this time fitting component **(O)** permanently into position using harpoon bolts or director screws as desired.

19 The length of the crosspieces **(L, M)** for the bottom rail assembly is determined in a similar way to that for the back rails, by temporarily fitting the rails **(I)** to the reassembled chair, back rails and hangers, and measuring the

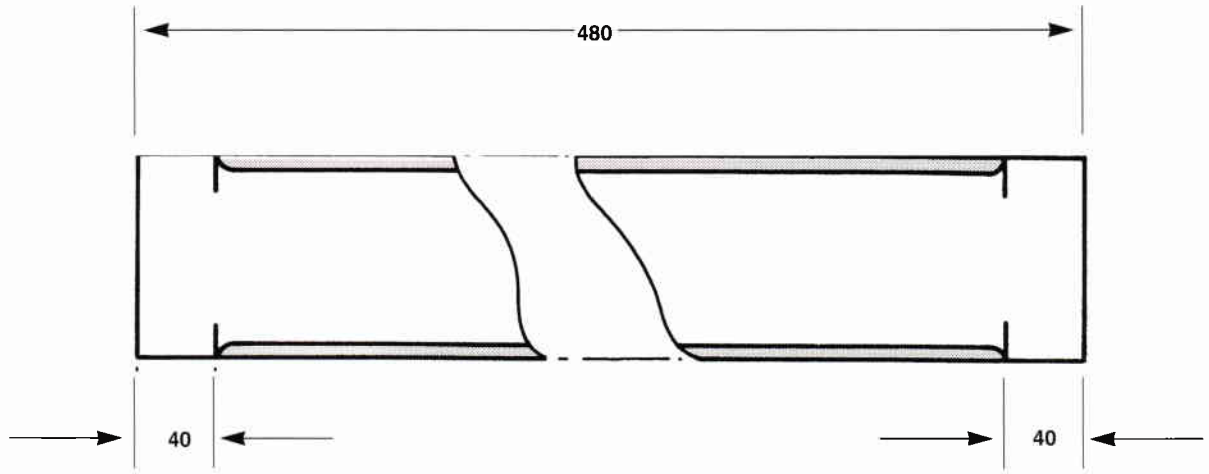

FIGURE 18

distance between them. Add 24mm for the two tenons and cut components **(L and M)** to length (should be 464mm). Make tenons for the crosspieces in the same way as before, noting that the shoulders on the footrest crosspiece **(L)** are only 3.5mm wide on their long edges, but 10mm wide on the short edges **(Figures 16 & 17)**.

20 Make through-mortices in the rail crosspiece **(M)** as shown in **Figure 16**, for the lower webbing attachment. Again, this is most simply done using a Triton Woodbit to drill through with overlapping holes, cleaning up the mortice with a narrow chisel or wood file. The webbing is passed through these slots on assembly, folded at right angles, and secured underneath with wood screws. Note that we have specified slightly overlength through mortices to allow for some sideway adjustment.

21 Before the bottom rails can be assembled the slats must be cut, shaped and fitted. The ten bottom rail slats look best if the rounding over is stopped short of where they meet with the side rails, for a neater fit in the long mortice in **(I)**.

A safe way to do this is as follows:

Pre-cut the 92 x 19mm material into 480mm lengths. Take five of these lengths, and mark two lines 400mm apart as shown in **Figure 18**. These will be your guides when starting and finishing the rounding over operation.

Convert to the shaper table mode, and fit a small-radius rounding over bit. Mark with pencil lines on the shaper table the front and rear extremities of the cutter, and round over all ten edges of the five components, starting and stopping the rounding over at the marked lines, using the pencil lines on your table as a guide. **Figure 19** shows the procedure.

For appearance we also beaded over the top front edge of footrest **(L)**, most conveniently done now.

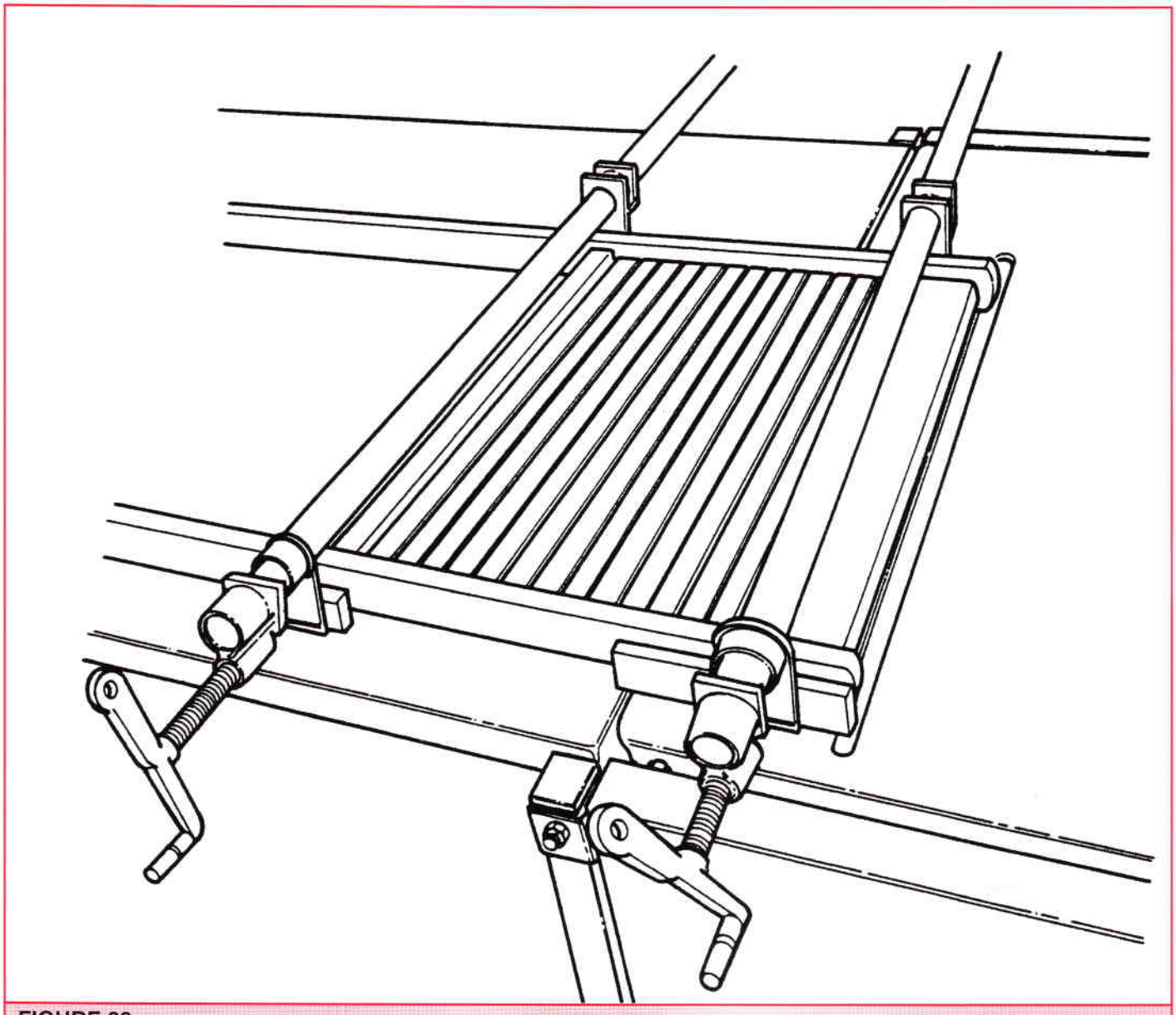

FIGURE 20

22 Set the table saw fence to 12mm and rip off the ten rounded over slats you have made, and set them aside. Then continue to rip the remaining 92 x 19 material into 19 x 12 slats, until you have a total of 55 plain slats and 10 rounded over with stops, i.e. 65 in total. It is a good idea to make up two or three extra slats, in case later adjustment in the spacing is required for comfort.

23 The 55 plain slats need to be rounded over on their front edges. You are working on narrow material close to the cutter, so you must observe all safety precautions.

Use timber subfences on your Router Table fence, set close to the cutter. Use a cutter with a ball bearing guide. Use the safety guard and use a push stick. Make the cuts in two shallow passes rather than one deep cut.

Plane or sand the front and rear faces of the slats by hand if desired to remove ripping marks, and finally round off the square ends of the slats using your Sanding Disc and 120 grit paper.

24 The ten slats with the stopped rounding over need to be shortened to 464mm by cutting an equal amount off each end. Use a length gauge on your workstops to ensure consistency.

Carry out a dry assembly of the bottom rail components; you will see that the square ends of two of these slats (the front and rear ones) need to have one of their edges rounded to match the rounded end of the long mortice; alternatively, you could chisel the ends of the mortice square. When this has been done push all the slats to one end of the mortice, measure the amount of space left and divide by 9.

This gives the width of the small filler blocks which separate the slats (should be about 5.5mm).

Rip a piece of leftover material to 12mm x 12mm and using a small handsaw cut 18 blocks 5.5mm wide to fit in the mortices.

25 You are now ready to assemble the components. The easiest way is as follows:

Lay one rail down with the mortices facing uppermost, apply glue as required and insert the footrest **(L)**, the front (rounded) slat, eight more slats, the rear (rounded) slat, and the crosspiece **(M)**, all vertically. Do not fit the spacer blocks yet.

Prepare the opposite rail with glue, lay the previously assembled components down horizontally and by angling the rail and working as quickly as possible insert the tenons and the other ends of the slats. Lightly clamp the two rails together on a flat surface and then fit the blocks to space the slats evenly. Clean up all excess glue with a wet rag and allow the assembly to dry.

Figure 20 shows the completed bottom rail assembly.

FIGURE 21

26 Drill out the excess glue and deepen the middle holes of **(I)** slightly with an appropriate sized bit to receive the threaded couplers, and fit two couplers to each side with a smear of epoxy glue as before. Fine-sand the complete assembly and test-fit in the chair.

If there is a gap between the washers and the outer face of the couplers, insert an extra washer or shim - do not over-tighten the pivot bolts to compensate or the couplers may be drawn out of their recesses.

27 The slats must now be screwed to the webbing. First divide the webbing into two equal pieces of 1.5m approximately. Insert each piece as far as it will go into its mortice in the headrest **(K)**. Lay the chair back assembly and webbing on a flat surface, front face downward, and slip the first slat underneath the two webbing strips, rounded face downward and an equal distance from each side rail.

Keeping the slat in contact with the headrest, drill and screw two small screws on each side through the webbing into the slat. We found it very easy to use power-driven Phillips-head screws, and a variable-speed electric drill.

Using a 5mm spacer strip of scrap material, position the next slat parallel with the first, and fix as before. Continue in this way, fitting the slats 5mm apart until all 55 have been fitted. **(Figure 21)**

Take care to keep the webbing strips parallel, and the slats central between the sides of the chair back rails. It is helpful to mark all the slats with a pencil line, about 60mm in from each end, to help in keeping them aligned.

Note that if your length dimension of **(K)** is slightly different from our specification, you will need to alter the exact positions of the pencil lines for slat alignment.

28 When all the slats have been fitted, remove the webbing from the mortices and coat the slats and all the components except that part of the webbing which will fit in the mortices, with two coats of the chosen finish. When dry, apply epoxy glue to the ends of the webbing, insert into the headrest mortices, and fix by drilling through the existing holes and the webbing with a 6mm woodbit, taking care not to break through the front face of the headrest.

Fit six short lengths of 6mm dowel with a smear of glue, and cut off the dowels flush with the surface using a sharp chisel. Stain and finish the end grain of the dowels to match the other components.

29 Assemble the chair components, using a smear of grease or silicone lubricant on the female threads. Tuck the free lower ends of the webbing down through the mortices in component **(M)**, bend them at right angles underneath and stuff the ends of the webbing back up through the footrest slats. This will retain the chair seat in place temporarily while the chair is tested.

Operate the movement, and check the 'hang' of the seat for comfort. Adjust the length of the webbing until the action and seat feel comfortable — one or more slats can be added or removed if desired.

When satisfied, bend the webbing sharply at a right angle underneath component **(M)**, and fix in place with three screws in each side. Cut off the excess webbing with a sharp knife.

30 The final steps are to fix the four rubber bump stops. Fix two rubber stops to the rear of component **(N)** with screws so that they stop the chair (contact against seat bottom rails **(I)**) at the reclining position.

Next, with the aid of a friend sitting in the chair in a comfortable upright position, hold the backstop **(F)** in place so that the seat back rails **(H)** are just in contact (allow for the thickness of the rubber bump stops), and mark its position on the outside of the leg braces **(D)**. (The backstop prevents the chair from moving too far backwards as the occupant attempts to rise from a seated position).

Drill and countersink through the rails **(D)** into the centre of the end grain of **(F)**, and fix in place using 'harpoon bolts' or 'director screws' as desired. Mark the contact point of the back rails and screw two small bump rubber stops to the face of **(F)**, angling **(F)** slightly if desired so that the back rails contact the bump rubbers at a right angle. Rubber feet can be fitted if needed to the leg bottoms to compensate for uneven floors.

This completes the construction of the project.