IN THE WORKSHOP

by "Duplex"

*40—Gear-cutting in the Lathe

THE making of the eccentric body or sheave (1) has already been described, and it now remains to give details of the construction of the eccentric strap, together with the other parts forming the rocking gear attached to the arbor. To bring to mind the arrangement of the various parts, reference should be made to the photographs and drawings given in the previous article.

for facing the back surface with the work mounted on a stub mandrel.

To mark-out the position of the threaded hole, into which the eccentric-rod fits, the previously scribed cross centre-line is continued across the width of the strap with the aid of a square; the centre of this line is determined with the jenny callipers then is punch-marked and centre-drilled.

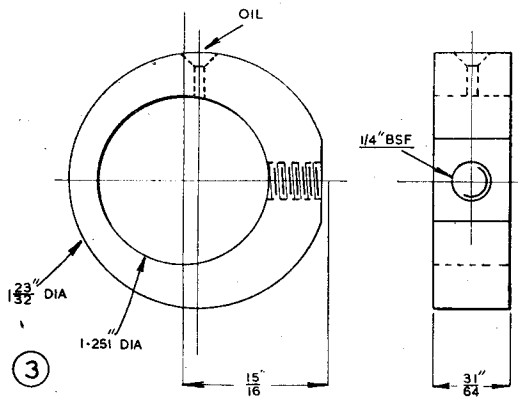

Fig. 13. *The eccentric strap*

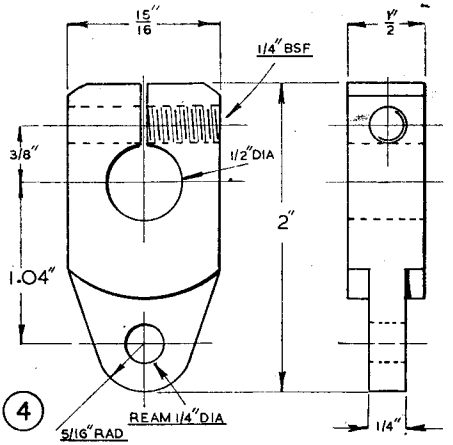

Fig. 14. *The arbor rocking arm*

The Eccentric Strap. Part 3. Fig. 13

To ensure good wearing qualities, either cast-iron or bronze is used for making the strap. A short length of suitable material of 1½ in. outside diameter is gripped to run truly in the four-jaw chuck, and is finish-turned on the outer diameter and then faced. The lathe tool is then fed across the face of the work to scribe the centre-line; this line should be cut rather deeply so that it is not obliterated when the second facing cut is taken at a later stage.

Remove the work from the chuck and with the jenny callipers set to ¾ in., scribe a mark crossing the centre-line; centre-punch the intersection of these two lines and drill with a centre drill. The work is now replaced in the four-jaw chuck, and with the aid of the wobbler the centre hole is set to run truly. After the bore to receive the eccentric sheave has been machined to provide a good working fit, the end of the bar is trued by taking a light facing cut, and the strap is parted off a little in excess of its finished width to allow

The next step is to set the strap on edge in the four-jaw chuck with the cross centre-line of the bore lying horizontally and at centre height; at the same time, the centre-drilled hole for the rod is set with the wobbler to run truly.

The centre hole is then drilled with a No. 4 drill and tapped ¼-in. B.S.F., and the abutment face for the nut fitted to the rod is formed with a facing tool, as represented in the drawing.

To complete the machining, an oil well is drilled on the upper surface of the strap or, if preferred, a cycle-type lubricator can be fitted, as shown in the photographs of the part.

The Arbor Arm. Part 4. Fig. 14

Mild steel is used to make this part and, although the machining is quite straightforward, it is essential that the ½-in. diameter bore should be a close fit on the end of the arbor, in order to ensure that when the cross-bolt is tightened the part is securely clamped in place.

The narrow tongue, on which the fork of the operating-rod fits, can be readily machined by clamping the part to a stub mandrel gripped in the chuck, and then removing the surplus metal

*Continued from page 746, "M.E.," June 16, 1949.

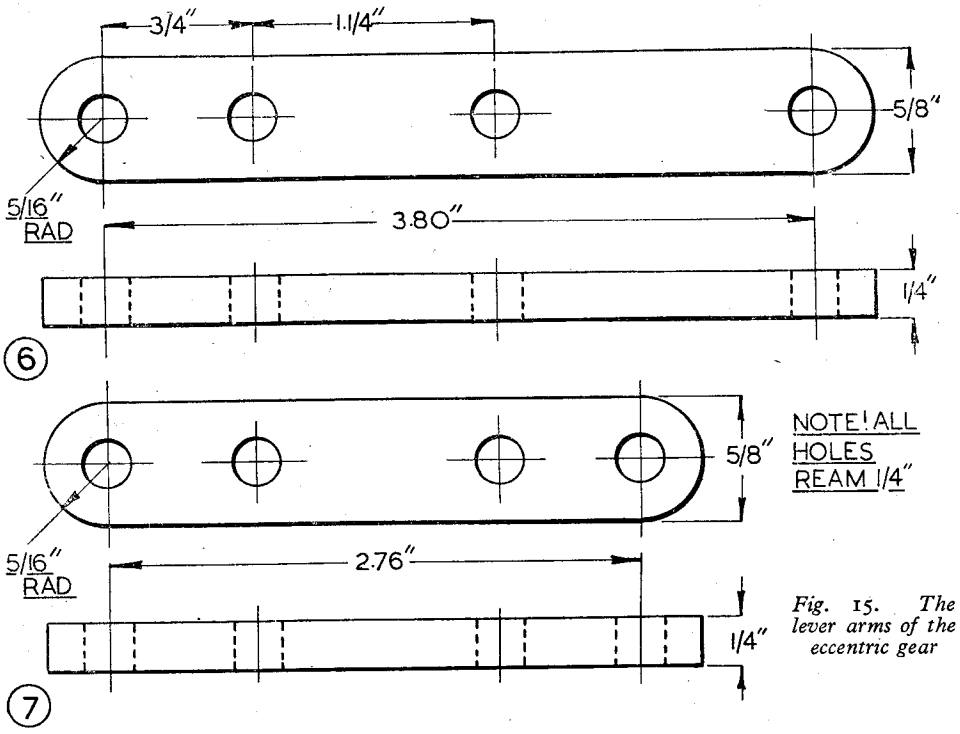

Fig. 15. The lever arms of the eccentric gear

by a turning operation. The pivot hole should be finished with a reamer and, if the appliance is to be subjected to much use, it may be found advisable to case-harden the part as a whole.

The Linkage Levers. Parts 6 and 7. Fig. 15

These parts are also made of mild steel and may, if desired, be case-hardened to resist wear at the pivot holes.

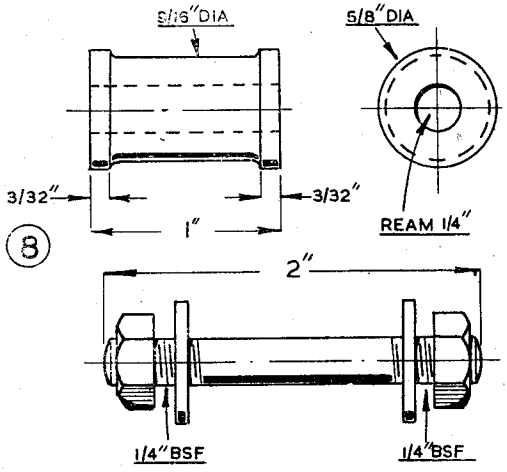

Fig. 16. The distance collars and bolts

The dimensions given are applicable to a lathe of 4 in. centre height, and for lathes of other sizes it is essential to maintain the exact relationships shown in the drawings, in order to impart the correct angular motion to the arbor when machining the gear cutters.

The Distance-pieces and Cross-bolts. Parts 8. Fig. 16

In conformity with the other parts comprising the eccentric mechanism, these fittings should be made of mild steel.

The machining is carried out in accordance with everyday practice and calls for no special comment.

The Pivot Pins. Fig. 17

These should be accurately fitted and preferably case-hardened to resist wear. The ends of the pins are grooved to take small cir-clips made of spring steel wire. These clips can be readily made by cutting off a single coil of a compression spring of suitable diameter, and then twisting the rings flat with the pliers. In the case of the pivot pin fitted to the arbor arm, one end carries a special clip of the form shown in the drawing; this is to enable this one pin to be readily withdrawn and so provide for the quick removal of the attachment from the lathe.

The Link Forks. Part 10. Fig. 18

These are made from $\frac{1}{2}$-in. square-section mild-steel bar, and the slots are machined with a circular milling-cutter while the material is

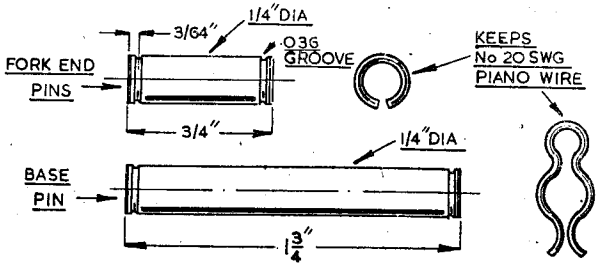

Fig. 17. The pivot pins and securing clips

secured in the lathe toolpost. The pivot holes and the threaded bores to receive the link-rods are marked-out and then drilled either in the lathe or the drilling machine. It is again advisable to case-harden these parts.

The Link Rods. Parts 11 and 12. Fig. 19

Mild-steel of $\frac{5}{16}$ in. diameter is used to make these parts, and it is essential that, when they are assembled, the eccentric and the arbor arm should take up the positions represented in Fig. 9, in order that the arbor itself is correctly operated in accordance with the design.

The Link Anchor Plate. Part 9. Fig. 20

Although the drawing shows this part as made for use with a 4-in. lathe, it may be found necessary to vary the details of its construction to suit the bed shears of any particular lathe.

The plate is located by means of a tenon secured in place by screws inserted from the under side.

The clamping plate and bolt of the design shown can be used where the bed shears are undercut, but, where this is not the case, it may be found necessary to make use of the angular guide-ways and fit clamping bolts of the type employed to secure the fixed steady to this form of lathe bed.

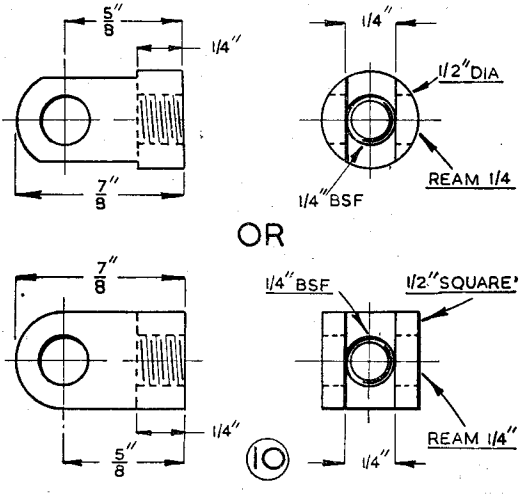

Fig. 18. The link-rod fork ends

This completes the construction of the cutter relieving attachment, and, next, the jigs and special tools required for the other machining operations on the cutter blank will be described.

Jigs for Machining the Cutters

In order to ensure uniformity in the gear cutters machined with the aid of the relieving device described, jigs are employed for indexing the cutter teeth. Although these jigs are of simple design and are easily made, it will be found that they greatly speed up the essential machining operations, especially when a number of cutters has to be made.

The actual machining of the cutters will be described later, but, first, it will be advisable to consider the construction of the necessary tools in order not to break the sequence of these machining operations.

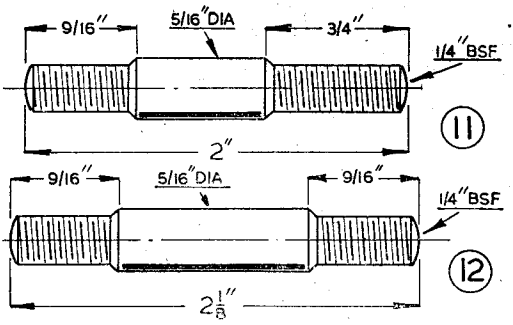

Fig. 19. The link-rods

The Cutter Drilling Jig. Figs. 21 and 22

The gear cutters, which are described in detail at a later stage, have an outside diameter of $1\frac{1}{2}$ in. and carry twelve teeth.

To enable these teeth to be accurately spaced, a series of twelve equally-spaced holes is drilled in the cutter blank by means of a jig of the form illustrated in Fig. 21, which shows the several parts of the device and a partly machined cutter blank in position.

The jig consists of a base or drilling block (A), a drilled jig plate (B), and a central clamping-bolt (C), as denoted in both the photograph and in the working drawings in Fig. 22.

The nut for the clamping-bolt is that already made to screw on to the arbor of the relieving attachment.

The base block is formed from a piece of $1\frac{1}{2}$-in. diameter round mild-steel bar which is gripped in the chuck and faced, and then bored $\frac{1}{2}$ in. diameter. The clearance groove to receive the point of the drill when the cutter blank is being drilled, is best machined with a square-face boring tool akin to that used for cutting internal square threads.

Next, the base-piece is parted off and, after

it has been reset in the chuck to run truly, the under surface is faced and the recess to accommodate the head of the clamp-bolt is machined with a boring tool.

The jig plate is made from a similar piece of material, and, when it has been faced, the bore is machined or bored and reamed to an exact fit on the arbor of the relieving attachment, that is to say, the end portion of the arbor designed to carry the cutter blank.

The twelve holes are drilled at this setting on a pitch circle $1\frac{1}{16}$ in. in diameter.

This drilling operation is carried out by indexing the lathe mandrel to twelve divisions, either with a headstock dividing attachment or by means of a change wheel secured to the lathe mandrel. To machine the holes, a short, stiff Slocomb drill is first entered, and this is followed by a $\frac{1}{8}$-in. diameter stub drill having a total length of about 1 in. These drills are either mounted in a drilling spindle attached to the lathe saddle, or the drilling attachment for the back toolpost, previously described, will serve this purpose well. The drill, mounted at centre height, is first set to the lathe centre-line and is then moved exactly 0.531 in. away from the centre-line, as determined by the cross slide index. The mouths of the holes should be lightly countersunk, either by means of the Slocomb drill in the first instance, or as a separate operation subsequent to drilling the holes.

Next, the jig plate is parted off to length, and if the under surface requires to be faced, the plate is mounted on a shouldered stub mandrel to ensure true running. Finally, the jig plate is case-hardened to enable it to withstand continued use.

The clamp-bolt is turned to an exact sliding fit in the bore of the jig plate, and the head portion

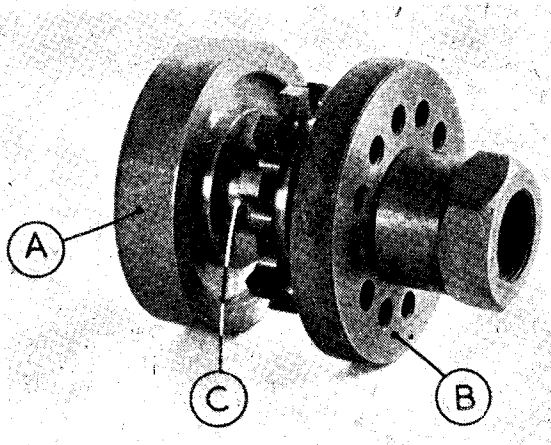

Fig. 21. The cutter drilling jig

should be made a firm press fit in the counterbore of the base to prevent the bolt turning when the nut is tightened ; if the parts have been properly fitted in this way, there should be no need to fit a snug or pin to the bolt-head for this purpose. Before the bolt is parted off to length, it is threaded for the clamp-nut either with the aid of the tailstock die-holder or, preferably, by employing a screw cutting operation.

The Sawing Jig. Figs. 23 and 24

As will be described in detail later, the teeth of the cutter are cut out by feeding the blank radially against a circular metal slitting saw mounted between the lathe centres ; and for this operation the cutter blank must again be correctly indexed to conform with the series of holes already drilled with the aid of the drilling jig. For this purpose, the jig illustrated in Fig. 23 is used, and it will be apparent that the index pin fitted to the shank of the tool will ensure that the teeth are correctly spaced.

The dimensions of the component parts of the jig are shown in the working drawings, Fig. 24. The material used to make the shank should be quite flat, in order to give a firm seating for the cutter and also to prevent the tool rocking when clamped in the lathe toolpost.

The clamping-bolt is turned to the correct diameter by using the drilling plate of the drilling jig as a gauge, and, as before, it is threaded to take the clamp-nut belonging to the arbor of the relieving attachment. The shank is bored to afford a firm press fit for the clamp-bolt, and, to ensure this, it may be found best to clamp

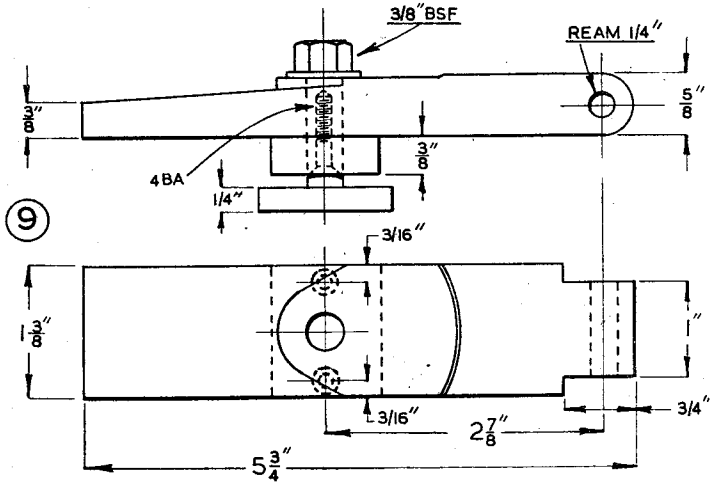

Fig. 20. The anchor block fitted to the lathe bed

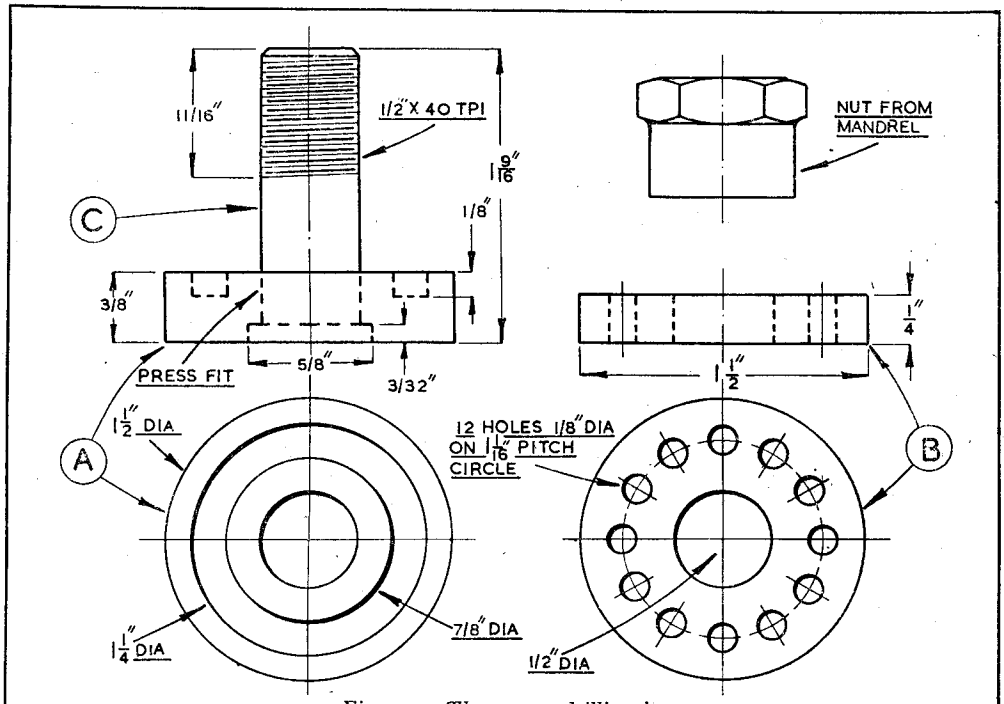

Fig. 22. The cutter drilling jig

the shank to the lathe faceplate and bore it in this position.

When the clamp-bolt has been fitted, the centre-line is marked-out on the shank, and the drilling plate of the drilling jig is clamped in place so that one of its holes is centred on this line. An $\frac{1}{8}$-in. diameter drill is then entered in this hole and fed in for a short distance ; this is followed by a No. 31 drill put right through the tool shank. The mouth of this hole may be opened out with an $\frac{1}{8}$-in. reamer, to afford a start for the $\frac{1}{8}$-in. diameter silver-steel register pin which is then pressed firmly into place in the vice.

At this stage, the arbor of the relieving attachment may be completed by having its register pin fitted. This is done, in the manner just described, by clamping the drilling jig plate to the end of the arbor so that one hole lies with its diameter in line with the line previously scribed on the arbor web.

This procedure enables the hole to receive the arbor register pin to be accurately located and drilled, as in the previous instance.

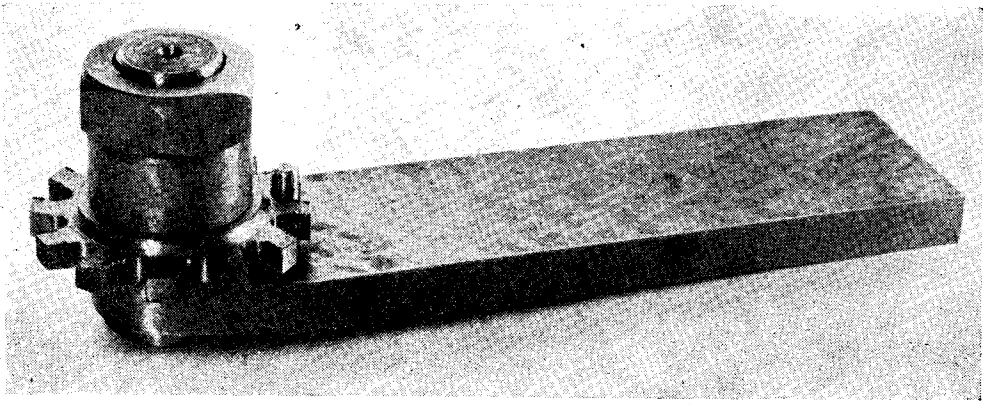

Fig. 23. The sawing jig for forming the cutter teeth

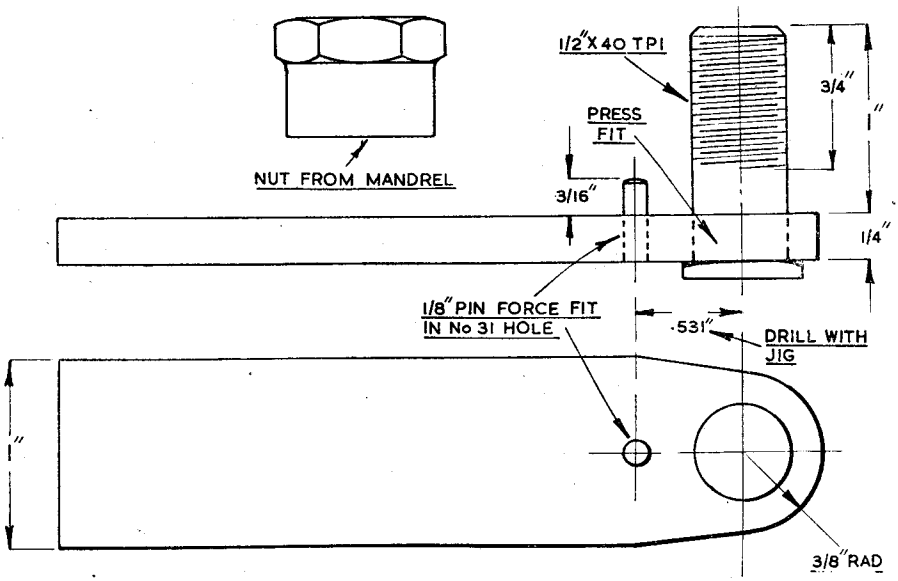

Fig. 24. The cutter sawing jig

If up to now the work has been properly carried out, it will be clear that the use of the hardened drilling plate of the drilling jig as a gauge will have enabled the cutter mountings to be machined to exactly the same diameter; moreover, the register pins fitted to the arbor, to the drilling jig, and to the sawing jig will be located at precisely the same centre distance.

(*To be continued*)

"L.B.S.C."

(*Continued from page* 795)

No. 40 holes, already marked out, at each end of the frame plate. Temporarily clamp the plates together, and make certain they line up all ways; then drill one hole at each end of the lower plate, using one of the already-drilled holes in the upper one as a guide, and temporarily rivet them together with a couple of 3/32-in. rivets. Drill all the holes through both plates at once, with No. 40 drill; then open out the larger ones with the drill sizes specified on the drawing.

To cut the frames to outline, when a shear isn't available, just catch the frames in the bench vice with the marked line showing level with the vice jaws. Put a fine-toothed hacksaw blade, say about 22 teeth per inch, sideways in the saw frame, and saw along the marked line with the side of the blade resting on top of the vice jaws, which thus guide the cut straight. A drop of cutting oil, as used for lathe turning, helps the saw to walk through the steel. Next, put the frames vertically in the vice, with the line marking side of hornblock slot showing at the jaws, and saw as far as the cross line. Drill a few holes just under the cross line, and break out the piece by grabbing it with a pair of pliers, and bending back and forth like a National Health Service dentist doing a bit of overtime. Finally, smooth out all the saw-marks with a file; knock out the temporary rivets, and there are your finished frame plates. The whole job shouldn't take more than one evening. Next stage, hornblocks, buffer-beams, and frame erection.