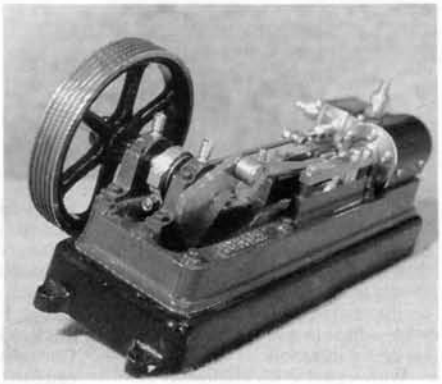


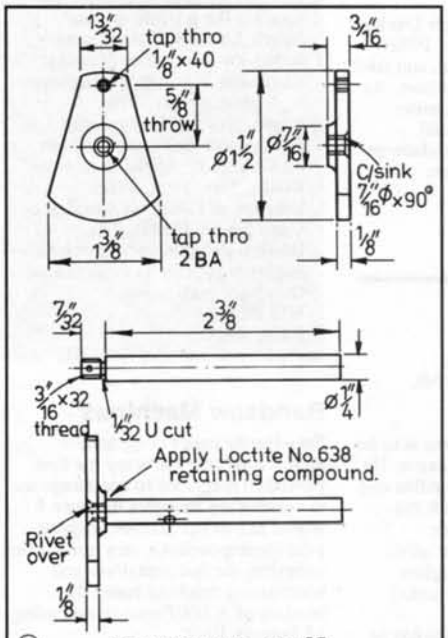
SALLY

The crankshaft

Tubal Cain

Describes how to build the crankshaft by detailing the shaft, crank disc and crankpin, and proposes some alternative methods of assembly.

● *Part VI continued from page 758 (18 December 1992)*



CRANKSHAFT Fig.35

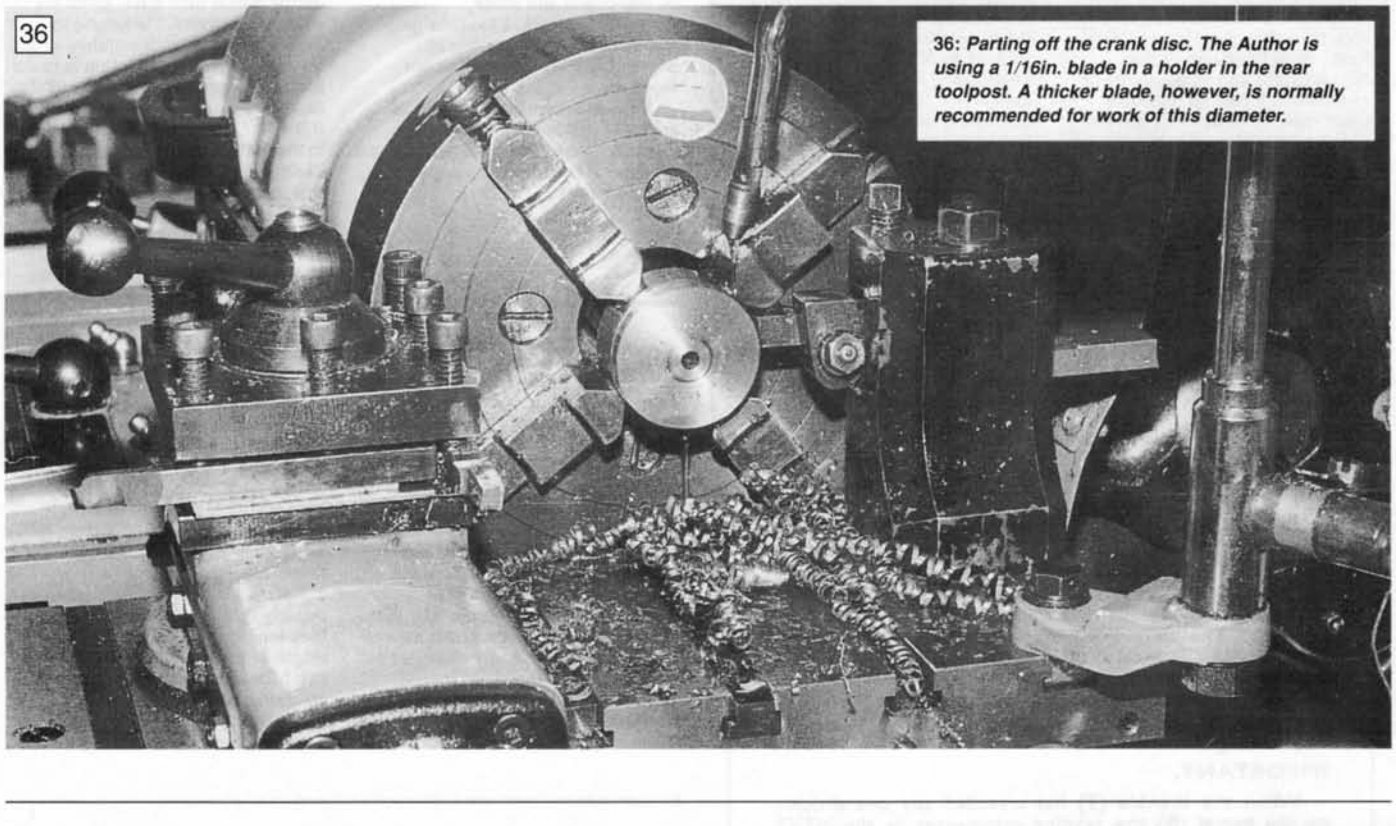
Crankshaft,

Part 36 & 37. **Fig.35**. One of the more enjoyable aspects of model engineering is that, except when making a true-to-prototype model, you can incorporate your own ideas from time to time. This crank is a case in point. First, you will have noticed that the web is balanced. This is quite untypical of mill engines, for they ran at such slow speeds that it was unnecessary. However, if you look at the bedplate you will see that a crank with a full disc could not be assembled. When the design was first brought out as a factory machined kit the connection between disc and shaft used a **left hand thread.** The shaft could then be screwed into the disc with the latter in place in the crankpit. When it was decided to offer the set unmachined it was realised that few model engineers would have such taps and die, and as a right hand thread might unscrew when working, the present screwed and riveted design was adopted, the disc being cut away to permit assembly. If you do have a set of L.H. screwing tackle, 2BA or, better, 3/16in. x 32 TPI (BSF) I suggest that you use this instead. However, riveting is not really necessary as Loctite 601 retaining compound will hold securely enough.

The alternatives, then, are: (a) A full disc, with L.H. threads, and no locking devices. (b) Balanced crank as drawn, R.H. thread, but 3/16in. x 32 TPI thread, using Loctite; (c) Plain push fit, no threads, also using Loctite 601 retaining compound. The latter is quite strong enough, you need have no fears about this. Most 5in. gauge locomotives nowadays have their wheels secured in this fashion. Other alterations are: (i) **Delete** the 3/16in. pip (really a dimple) shown on the shaft. Leave this until you have set the valve timing. (ii) **Delete** the references to a mills pin and the cross-hole in the screw thread; both are redundant. I shall describe method (b) above, since this will cover most of the work for all. I am using 3/16in. x 32 TPI (40 TPI would do) because you can then rough screwcut the shaft thread before using a die, with much less risk of having the disc run crooked.

Crankweb.

The material provided is a chunk of fairly free-cutting steel, which is already 1½in. dia. Remove the burrs and then chuck in the 4-jaw with about ⅜in. projecting and set to run really true. Make



36: ***Parting off the crank disc. The Author is using a 1/16in. blade in a holder in the rear toolpost. A thicker blade, however, is normally recommended for work of this diameter.***

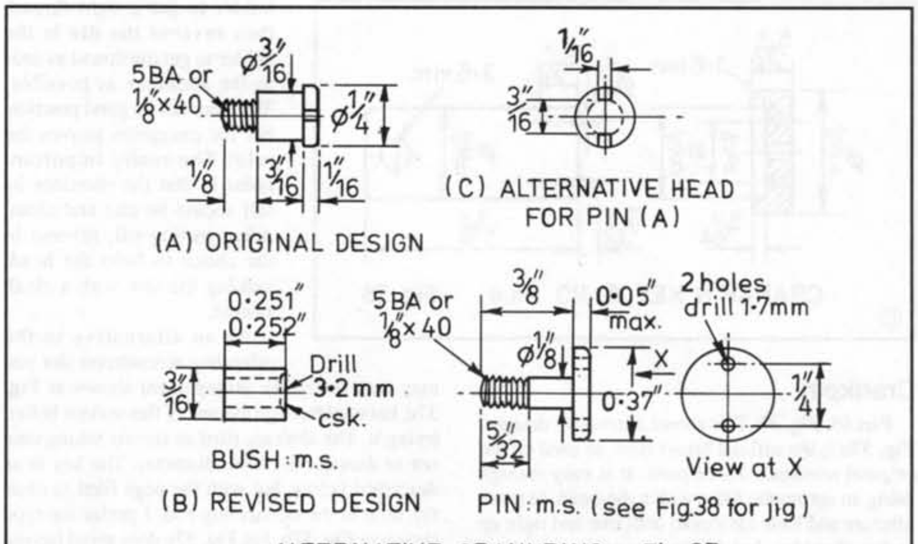
sure you have a firm grip and face the end. Take the slightest skim off the diameter to get a good finish at about 200 rpm, no more; use cutting fluid. Centre the end with a slocumbe drill, follow with a 4.1mm drill (speed up for this) going at least ½in. deep. Then, using a tool with a small point radius, form the boss to stand proud by 1/16in. – use your topslide index to get this right. Hone the tool for the final cut to get a really good finish. Remove the sharp edge at the rim. This done, set your scribing block exactly to centre-height (I have one permanently set, which also serves to set tool points correctly) to scribe a short line – about 3/16in. long – from the edge on one side and just a mere trace of a line at the opposite diameter. Set these vertical, and scribe a cross-line 5/8in. **below** centre on the longer of the first lines.

To tap the hole, guide the tap from the tailstock drill chuck and take the taper tap in as far as it will go. Follow with the second tap for about four threads, then the bottoming tap likewise. Revert to the second tap for a further six threads, then take the bottoming in for at least 8 threads. Use a tapping oil and don't forget to reverse the tap every turn. This procedure should ensure that the thread runs true. If you have no taper thread tap, use the seconds tap, the bottoming tap to go in two less threads than the second at each change. Finally, very lightly countersink the entrance.

Now check your parting tool – I have already said something about this in part I of the series, *M.E.* 21 August 1992. Make sure the end is honed really sharp, is dead square, and exactly at centre-height. You will need a projection of at least 11/16in. clear. Above all, ensure that the blade is dead square across the bed. Despite all this there is a slight risk that, if you are using a 1/16in. blade in a holder, the cut may run sideways a trifle. That being so, set the point to part off just a shade over the desired 1/8in. thick; drop the speed to 90 rpm or less, depending on the condition of your lathe. Use a continuous drip of cutting oil, keeping the slit well filled; feed slowly and steadily – it will take time, but even at 1 thou/rev you will be through in about 7 minutes! **Fig.36**. The secret of parting off is a really sharp, correctly set tool and a **steady feed.** Check the thickness of the disc with your micrometer, to see what remedial treatment may be required later.

Shaft

Part 37. Check your self-centring chuck for truth; if it runs out more than 1½ thou, use the 4-jaw instead, but take care not to mark the stock. Set as true as you can, and then, after facing the end, turn down with your knife tool to 0.187in. dia. 1/4in. long. Take care to get a good finish on the 1/4in. long shoulder and then form the little undercut, at least 20 thou deep for 32 tpi, 16 thou for 40 tpi. Use the micro screwcutting tool shown in Fig. 3B, with only the barest radius on the tip – just take off the sharp edge. Set up for 32 tpi, and start cutting **turning the machine by hand.** Take a 5 thou cut first pass, stopping before impacting the shoulder. Then 3 thou, then drop down to 2. There is absolutely no need at all to set over the topslide for a job like this – I never do so, even for large pitch threads. When you have fed in about 6 thou total, just move the tool sideways a trifle – barely a thou – and carry on. When the tool total depth of cut is 17 or 18 thou for 32 tpi or 13-14 thou for 40

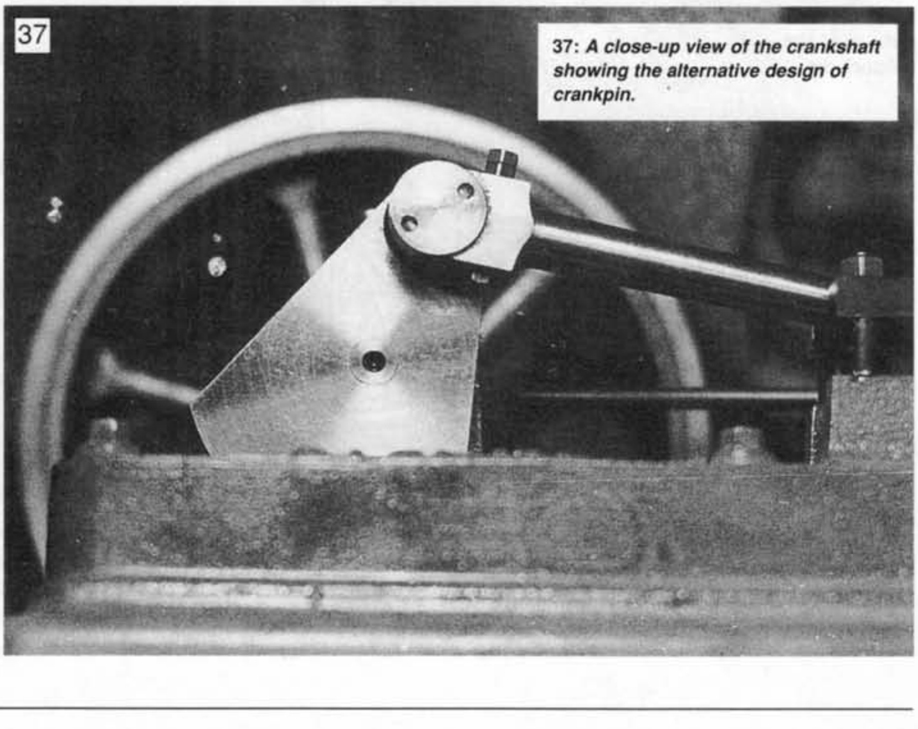


ALTERNATIVE CRANKPINS Fig.37

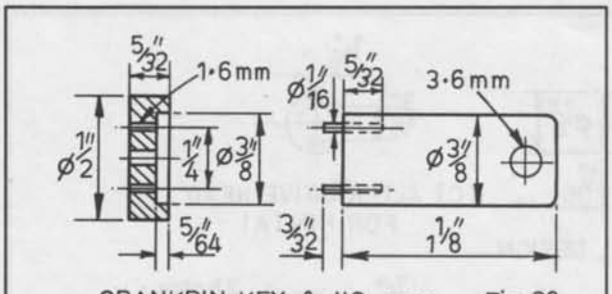
tpi disengage the changewheels and use your knife tool to set a slight bevel on the end of the rough thread. Now fit the appropriate die into the tailstock die-holder and having opened the die with the centre screw finish the thread. It should be a good but not tight fit to the disc crank. If the latter does not run tight up to the shoulder, enlarge the recess until it does - as a rule, it will be width that lacks, not depth.

You should now turn your attention to the face of the disc. If it is concave or convex attention is essential. If more than 0.005in. over thickness, attention is also needed. There are two ways of handling this. That mentioned in "books"is to screw it onto the shaft, grip the latter in the 3-jaw, and reface. This has the merit that the face and shaft will run true to each other, but as a rule chatter is very likely during machining. The second method is to grip in the outside jaws of the chuck with sufficient packing behind to allow about 1/32in. projection. This is the method I prefer, but you **must** tap the workpiece backwards to ensure that it beds evenly onto the packing. Take gentle cuts – not less than 0.003in. though – and keep a steady feed at between 150 and 200 rpm, using cutting fluid to get a really good finish. Remove the sharp edge.

The final jobs on the crank are the hole for the crankpin and forming the shape - if you are not using a complete disc. Centre-pop for the hole, but before drilling scribe two faint lines at 3/16in. radius. Go to the faint line opposite and, using this as centre, scribe faint lines at the edge, at 11/16in. radius. Join these with straight lines. Then drill the hole either for 5BA or (better) 1/8in. dia. x 40 tpi. Guide the tap when tapping, from the drill-chuck, as you did before. Lightly countersink the hole both sides. This done, set to and saw across the disc a little clear of the scribed lines. File down to the lines, taking care to keep the file flat across, and finish by draw-filing using the finest file you have – and clean it first! Remove all burrs.



37: A close-up view of the crankshaft showing the alternative design of crankpin.



CRANKPIN KEY & JIG m.s. Fig. 38

Crankpin

Part 46, **Fig. 37.** This shows alternative designs. **Fig. 37a** is the official Stuart type, as used on the original machined kit of parts. It is easy enough using an automatic lathe with a die-head, to manufacture and have the thread both true and right up to the shoulder, but by no means as easy on a model engineer's lathe. Then there is the question of realism; true, this is not a model of a prototype, but even so, screwdriver slots are not really appropriate on a crankpin! **Fig. 37b** is an alternative, much easier to make, and although the two peg-holes may not be prototypical they are not as obtrusive as the slot. The disadvantages are (i) that you have to make a special key to tighten it – and a jig to drill the holes; and (ii) you may have to do a little extra work on the bedplate to make sure there is sufficient clearance in the crankpit. The photo, **Fig. 37c**, shows the appearance of the new design.

So far as **Fig. 37a** is concerned, this is a normal turning job, but take care to get the 3/16in. dia. both dead to size and a good finish; polishing is permissible here! The thread is not so easy. If you have used ⅛in. x 40 TPI on the disc, then you can rough screwcut it as for the shaft, but that is not the problem; even then you will not be able to get right up to the shoulder and possibly will manage only 3 full threads. The trick here is to make the usual tiny undercut, use the tailstock dieholder to get a tight thread, then **reverse the die** in the holder to get the thread as near to the shoulder as possible. This may not be good practice, but the exception proves the rule! The really important point is that the shoulder itself should be true and clean. After parting off, reverse in the chuck to form the head, making the slot with a clean sawcut.

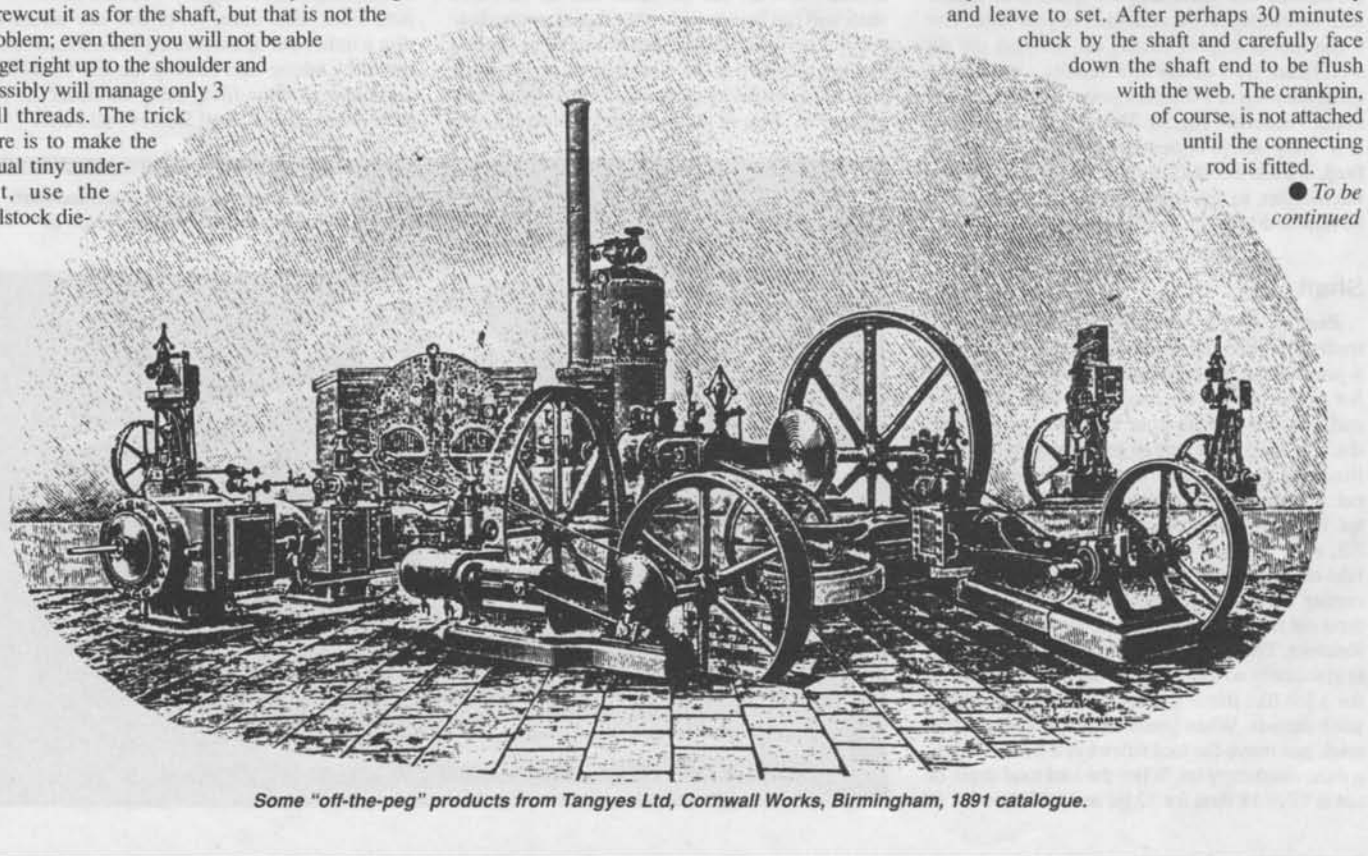
As an alternative to the offending screwdriver slot you may care to try the arrangement shown at **Fig. 37c**, but read through the rest of this section before trying it. The slots are filed as shown, taking care not to damage the 3/16in. diameter. The key is as described below, but with the pegs filed to clear the hole in the connecting rod. I prefer the type shown in **Fig. 37b**, but **Fig. 37c** does avoid having to deal with the clearance in the crankpit - again, referred to below.

The **alternative Fig. 37b**, is much easier in the turning, but you'll need to make the little jig and the special key shown in **Fig. 38** as well. So far as the pin and bush are concerned these need little comment, except that the 3/16 dia. pin must be dead size and polished. The screw can be threaded with the tailstock dieholder with no difficulty. After parting off, reverse in the chuck to face the head. The little jig, **Fig. 38**, is made from any scrap piece of ½in. steel, long enough to make both jig and key. Face the end. Then mark out a cross-line at centre height, and two cross-lines at ⅛in. from centre. Remove from the chuck, centre-pop, and drill two holes 1. 6mm dia. and about 7/32in. deep. Take care that the workpiece is upright whilst drilling. Return to the chuck. Centre, and drill a hole ⅛in. dia. about ¼in. deep. Follow with 11/32in. x ⅛in. deep, then bore to fit the flange on the crankpin screw, flat bottoming the hole at the same time. Face off to make the recess 3/64in. deep and then part off 5/32in. thick.

The **special key** is made from the same material. Face the end clean and turn down to fit the recess in the jig. Set it upright in your drilling vice, slip on the jig, and drill one hole 3/32in. deep. Slip a piece of 1/16in. rod through both jig and key to locate it whilst drilling the other hole. Cross-drill the other end for the tommy-bar. Treat the head of the crankpin the same way. Then drop in a piece of 1/16in. silver steel into each hole in the key, cut off to project 3/32in., round off the ends, and secure with Loctite 601 retaining compound.

Before assembling all, check the *length* of the bush to **Fig. 37b**. This should be just the odd thou more than 0.250in.; if more, grip gently in the 3-jaw and skim the end. Remove all burrs afterwards, of course. You can now fit the crankpin complete, tighten (not excessively) with the key then the crankweb to the shaft, and offer all up in the bed. You will almost certainly find that it fouls in the crankpit. Proceed as follows. First, slightly increase the depth of spotface on the main bearing, using a file if need be, to bring the width of that main bearing cap to 5/16in. If the crankpin still fouls the bed, then you must use a file in the side of the crankpit. You really need a medium/coarse riffler file for this sort of job - these are files which have short bent working surfaces, invaluable for many jobs. Your usual tool dealer should be able to supply. Carry on until you have 1/64in. clearance. You will not need to take much off the top edge, of course. Once the crank rotates freely you can permanently assemble the web to the shaft. Clean both parts, apply Loctite 601 or 638 retaining compound to the threads, screw in the shaft firmly and leave to set. After perhaps 30 minutes chuck by the shaft and carefully face down the shaft end to be flush with the web. The crankpin, of course, is not attached until the connecting rod is fitted.

● *To be continued*



Some "off-the-peg" products from Tangyes Ltd, Cornwall Works, Birmingham, 1891 catalogue.