A useful tool grinding jig

J. NIXON describes an accessory essential for precision lathe work

THE OBJECT OF this article is to enable the model engineer to produce accurate flat faces on the tool-faces which can be struck again instantly on a regrind. Perhaps its first recommendation is that it can be produced by anyone possessing a 3½ in. lathe. Next, in order of merit, is that it can be produced from scrap.

As a matter of expediency the prototype has been built up from aluminium alloy angles and plate, and for this reason, perhaps, the scantlings are on the heavy side. In steel, all thicknesses, with the possible exception of the top plate, could be reduced, but this is a matter of individual taste.

Any grinding jig can, of course, be offered up to the wheel at any unusual angle, but usually an alteration in the angular inclination entails a consequent shift towards, or away from, the wheel face if safe and efficient support is to be given to the tip of the tool.

The next most desirable feature of the appliance is that it can be secured permanently to the bench with the edge of the top table no more than just clear of the wheel. The top table rolls round an axis coincident with its front edge-protractor markings on one side angle enabling it to be set at any desired angle within its scope. The addition of another protractor on the top plate enables the operator to carry out double angle grinding.

Not all tools may be ground with equal facility, of course, but with the aid of a few simple accessories, any normal tool can be precision ground as to front and side clearance and side rake. This category would include right- and left-hand knife tools, roughing tools with flat faces, screwcutting and parting tools. Round-nose tools with a common clearance at front and sides may also be ground by using the top table alone, set to the appropriate angle.

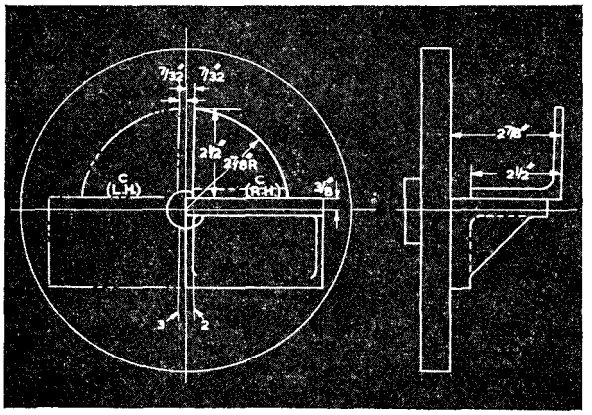
The jig illustrated is used at the side of the wheel and it is possible that modification to the guard may be necessary to accommodate it. It is essentially intended for tool finishing and would, therefore, be set up to the fine wheel of a double-ended grinder. When forming a new tool from a stock bit, the roughing-out is done by hand on the coarse wheel. The angle is tested from time to time by touching it to the fine wheel with the jig set to the appropriate angles-the final grind is done on the fine wheel, of course.

Once established, the tool angles can be struck again at any time. The setting of the jig and the grinding of a normally blunted tool is a matter of seconds; honing, too, is reduced to the minimum

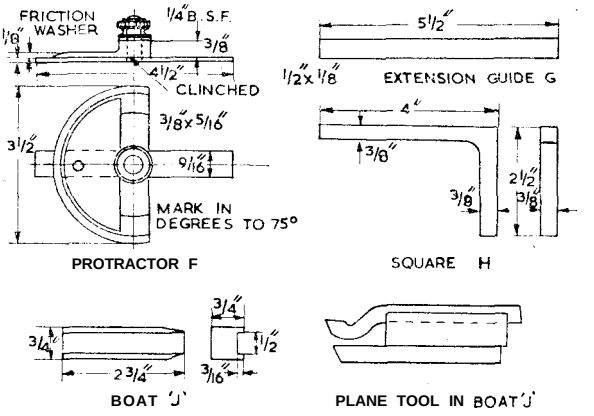
The table top

For this a slab of plate ⅜ in. x 10½ in. x 4 in. is required. It should be flattened to a straight-edge to reduce filing or machining. It is then cut to shape using hacksaw and file. The centre recess

Fig. 1: The setting for the trunnions



Details of the protractor "F"



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on the front edge is made to accommodate the nut and washer securing the wheel.

It is not really necessary to machine the top face but it should be smooth and flat to promote easy manipulation of the protractor guide. A groove, $\frac{9}{16}$ in. wide x $\frac{1}{8}$ in. deep is machined in the top face to accommodate the guide bar. This can be done by setting up the plate on angle plates secured to the cross slide with the centre line of the groove at lathe centre height-a $\frac{9}{16}$ in. end mill in the s.c. chuck is employed.

It is unlikely that the full length of the groove can be machined at one setting as few slides on small lathes have the necessary travel, but a careful re-setting will enable this operation to be completed. That part of the inner edge of the plate remaining after it is gapped for the wheel nut must be bevelled to an included angle of 60 deg. or slightly less.

Later it will be necessary to cut two small notches in the outer edge $\frac{1}{4}$ in. wide x $\frac{1}{16}$ in. deep to give passage to the trunnion bearing flange when the angularity of the top table approaches the maximum.

The **sole plate**

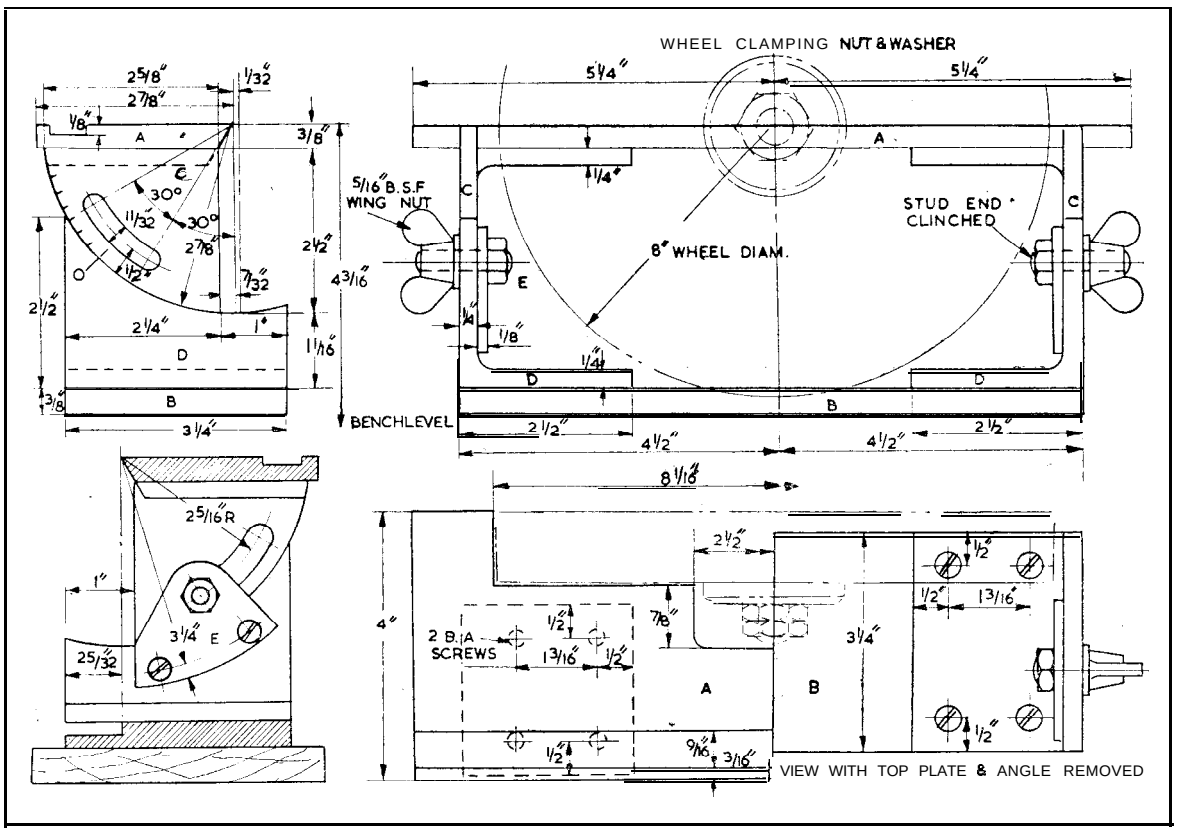
This is a simple rectangular piece of plate which can be made by hacksaw and file. It should be reasonably flat otherwise it may distort when screwed down to the bench and tend to jam the trunnions. If the wheel is the full 8 in. dia., a recess in the upper surface will need to be cut. Holes for the holding-down screws are left to individual requirements.

Top trunnions

It will be seen that the bearing edges of these are machined to a radius struck from a centre outside their surfaces. They are formed from $2\frac{1}{2}$ in. x $2\frac{1}{2}$ in. x fin. angle bar, each $2\frac{5}{8}$ in. long. The outside faces of the flanges should be checked for 90 deg. angularity and corrected if necessary.

The cross-sectional edges should be squared off to assist setting-up for machining. For the purpose of roughing out the radii, a tin or card template may be used with advantage for marking out ; the

Details and dimensions for the tool jig for the grinder



surplus is then readily removed with a hacksaw.

Before setting up for machining, guide lines (Fig. 1) are lightly marked on the facedate-these fix the positions of the edges of the angle bars. With the scribing block on the lathe bed., scribe the first mark $\frac{3}{8}$ in. (or the finished thickness of the top plate) above the lathe centre, carrying the line right across the faceplate. Now turn the mandrel through 90 deg. so that this first line is vertical to the shears.

Scribing the location lines

Scribe two further lines (Nos. 2 and 3), 7/32 in. above and below the lathe centre. **These are the** locating lines for the inner edges of the right- and left-hand trunnion angles. The sketch shows how these lines appear when completed. Return the mandrel to its original position and bolt on the angle plate with its heel edge set to the line, in the lower back quadrant.

Secure the right-hand trunnions to the angle plate, taking care that its outer flange overhangs the edge of the angle plate by about $\frac{3}{8}$ in. (Fig. 1). The vertical flange of the tnmnions is set parallel to the faceplate with its toe in line with No. 2 line, i.e., 7/32 in. off-centre.

In slow back-gear turn this edge until the tool is just touching the toe of the $2\frac{1}{2}$ in. edge. The heel of the trunnion should now measure $2\frac{5}{8}$ in. (approximately) and the radius about $2\frac{7}{8}$ in. The left hand trnnnion should be machined in a similar fashion, but with the angle plate mounted on the faceplate in the lower, front quadrant. If two angle plates are available, both trunnions can be machined in one operation.

Cutting the zero line

With a sharp V-pointed tool, the centre line foi the radial slots should be marked $\frac{1}{2}$ in. from the turned edge; likewise the line which borders the protractor marking 5/32 in. from the edge. With the same tool mounted on its side at lathe centre height a zero line is cut on the face of the trunnion at an angle of 45 deg.

Some form of dividing is desirable for cutting in the protractor markings but failing this, a draughtsman's protractor can be set up with the exercise of a little ingenuity and used as a dividing head with sufficient accuracy for most requirements. Short lines at every degree, with slightly longer ones at the 5 deg. and 10 deg. stations are engraved by feeding in the cross slide for the requisite amount. Figures ($\frac{1}{16}$ in.) stamped later at every 5 deg. station assist in setting when the jig is in use.

Protractor markings

It will be noted that protractor markings need be engraved on one trunnion only. The opposite trunnion requires only the centre **line** for the slot to be marked in at this stage. The slots could be milled in before dismounting by the use of a slide rest mounted milling spindle. Failing this, the slots are drilled out and finished bv filing. Do not omit to bevel the inside edges of the-top flanges to an angle of 60 deg., as shown.

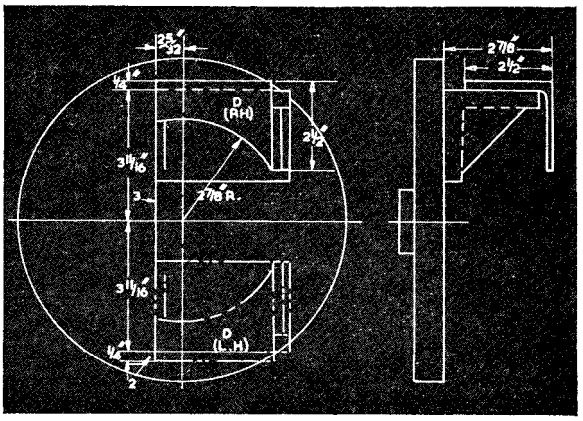


Fig. 2: The setting for the bearings

In the initial stages the trunnion bearings should be dealt with. As far as roughing-out is concerned this is done in a similar fashion to their mating angles C, again bearing in mind that there is a left- and a right-hand unit. The angle sections in this instance are 39 in. long.

Setting up trunnion bearings

Again they are set up on the angle plate secured to the faceplate in the settings appropriate for a boring operation. It is possible that the off-set required may tax the faceplate beyond its capacity, in which case the work piece could be mounted with its inner surface to the angle plate (Fig. 2), due allowance being made for flange thickness if the angle plate has to be reversed.

For this operation, the lines inscribed on the faceplate are 1 and 2, $3\frac{15}{16}$ in. above and below centre height and 3 25/32 in. to the left of centre. Machining is carried on with a boring tool until its point is just scraping the toe of the flange as before.

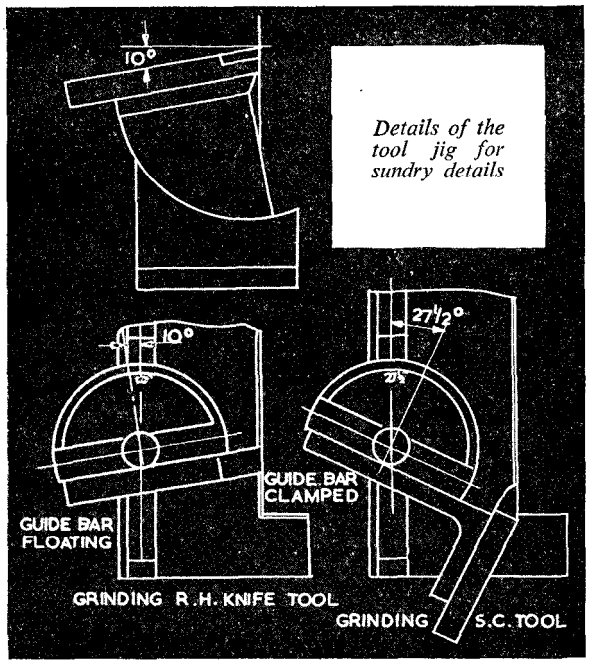
It is a wise plan to check the radius produced, as the operation approaches completion by using the mating trunnion as a gauge. A smear of blue on the bearing edge of the latter will indicate progress and machining should be stopped when the two surfaces are shown to be mating. A touch with a scraper at the bench should then ensure smooth action between the two parts.

Clamp assemblies

The shapes of these $\frac{1}{8}$ in. plates are identical, but, on assembly, they need to be handed to right and left, therefore the securing studs must be screwed through the plate to suit. No. 2 B.A. clear holes are drilled and countersunk.

The clamp plates, secured to the trunnion angles in the correct setting, are used as jigs for marking off the tapped holes in the bearing angles. It is wise to lock the clamp plates in position with the studs at the extreme ends of the slots-this precaution enables the table to be returned to zero without checking when in use.

With the trunnions and bearings and clamp plates assembled after drilling 2 B.A. clear holes in the top



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and base flanges, they are secured to the table top and sole plate in turn for drilling the tapped holes in the latter parts. The setting should be carried out with maximum care for, as will be realised, the set-up is now the equivalent of a shaft rolling in a bearing.

Ensuring smooth working

If the trunnions are not axially true in their bearings the smooth working of the apparatus will be destroyed for the same reason that a bent shaft will not turn in a bearing. To prevent this, the trunnion and bearing angles should be secured temporarily to the top and sole plates by means of clamps. When the desired freedom of working is ensured the holes are marked off, or drilled by using the angles as jigs.

With the fastening screws in place, the main unit is substantially complete. It is almost certain that packing will be needed to bring the surface of the top plate reasonably into line with the centre of the stone. A slab of seasoned hard wood should be chosen and bedded to the bench top to avoid rock—obviously the top surface of the packing should make an exact right angle with the side of the stone.

Nuts for holding down

For the purpose of holding down, $\frac{5}{16}$ in. square nuts may be sunk into the under surface of the packing before the latter is screwed down to the bench-the holding down screws then screw in from the top. The holes for these through the packing should be drilled a little oversize to give some latitude to the setting of the jig.

Top **plate** protractor guide

The drawing is self explanatory and the only difficulty is the marking of the scale. Here again, in the absence of dividing apparatus, a draughtsman's protractor can be made-to serve. A special mark should be made at 278 deg. on either side of the zero line, thus being half-the-angle of Whitworth screwcutting tools.

For the sake of stiffness the guide strip which engages in the groove in the top plate should be of steel. It should bear on the bottom of the groove and the top surface should stand a thou. or two proud of the surface of the top plate A. This ensures that the clamp will hold it securely without distortion. Needless to say, the strip should be. a sliding fit in the groove.

The remaining accessories, the extension guide (G), the square (*H*) and the " boat "(*J*) are simple and easy to make. The G-clamp can be bought for a shilling or so at any tool dealers.

Guide is left floating

The protractor is used for all normal, simple tools such as right- and left-hand knife tools, roughing and parting tools and, in fact, any tool which has flat facets which do not deviate too far from the zero angle. In grinding the tools mentioned, the protractor guide is left floating and is worked to and fro with one hand along the groove, while the tool is nresented to the stone with the other hand, so distributing the wear on the latter as far as possible.

It will be noted that if the angle of the tool is too acute, the influence of the guiding edge of the protractor is lost, particularly on short tools. Tool-holder and boring-bar bits, for example, are not easy to align with the protractor swung round to a large angle.

In this circumstance, the extension guide (G) is brought into use. The protractor is set to the desired angle and fixed at a suitable station on the top plate by means of the G-clamp. The extension guide is laid along the edge of the protractor with one end near to the stone, thus supplying the necessary guiding edge to the short tool

Making it a short interlude

The square will be found necessary when grinding acute angles, which operation is illustrated in the sketch. It is also used when grinding the top faces of tools with the table set to give the necessary side rake and the protractor set for zero, positive or negative back rake, the latter being necessary when grinding certain tool-holder bits, particularly those for screw cutting in a Jones and Shipman tool holder, for example.

The boat (*J*) is used for underlining tools such as planer and shaper tools. A little preliminary practice with the apparatus will transform the chore of tool grinding into nothing more than a very short interlude in the more serious business of getting on with the job, as well as removing the question of tool angles from the realms of guesswork. El