Continued from **January** 1

By Ned

This INDEXING GEAR is accurate and quite easy to construct

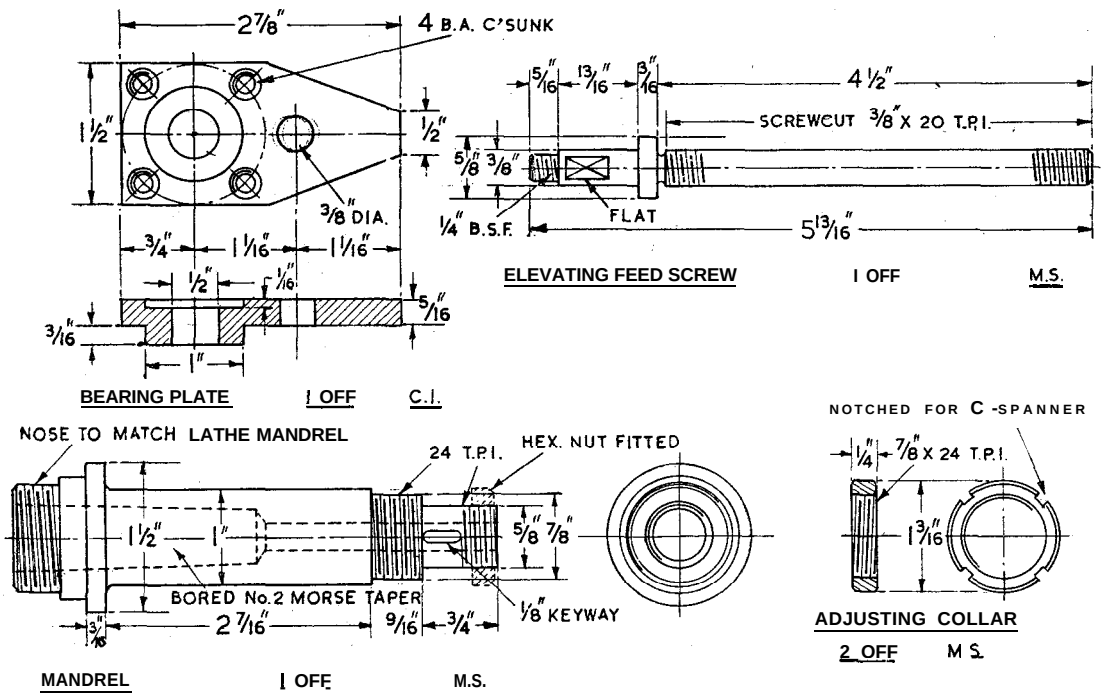
THE bearing plate which fits on the top of the square pillar may be made from a casting or machined from solid material. Both sides should be machined parallel, and the spigot on the underside should fit the recess in the top face of the pillar. A recess in the upper side of the plate, just large enough to clear the comers of the 1/2 in. holding-down nut, allows this nut to be made thick enough for ample strength without undue projection above the plate surface. The four countersunk screws serve only to maintain correct alignment of the feedscrew bearing, and need'be no larger than 4 BA. No details of the tapped holes to take these screws were shown in the drawing of the pillar on December I5, but it will be obvious that they are located from the holes in the plate.

Similarly, the tapped hole in the quill housing, to take the feedscrew, was not shown, as you can more accurately assure its location by spotting through from the hole in the bearing plate, when the parts are assembled on the pillar, than by measurement. It is, of course, essential that the drilling and tapping of this hole should be truly parallel to the vertical face of the pillar. The best way to ensure this, after you have located the hole position, is to set the housing up on an angle plate, with its machined under face bedded firmly against the faceplate. Unless you have a clearanced or through tap, with its shank undercut below the tapping hole diameter, you cannot cut the thread throughout the full 2 1/4 in. depth of the housing; but this will not be necessary, as 3/4 in. depth of thread is ample, and the rest of the length of the hole may be opened out to clearance size.

The elevating fee&crew may be turned between centres from 5/8 in. mild steel bar; this size will provide a substantial thrust collar, though the collar can be brazed on (before the final machining) if you wish to economise in material. The thread should be screwcut, and finished with a chaser; dies often produce an imperfect thread form, and also a pitch error, but a good quality die nut could be used for final sizing of the thread.

To attach the handwheel, several alternative methods are practicable. The arrangement shown is simple and satisfactory. A flat is filed or machined on the shank of the screw, to form a seating for a 2 BA Allen grubscrew in the handwheel hub. This locks it against torque, after the endwise clearance has been adjusted by a 1/4 in. nut on the end of the feedscrew. An indexing pointer may be attached to the small end of the bearing plate, or in any other convenient position.

The indexing mandrel may be varied ***in*** design to suit your convenience; it may be adapted to take standard draw-in collets if you prefer, and the screwed nose may not be needed, in which event it may be shortened to reduce overhang. But there are advantages in the ability to transfer chucks and other fittings from the lathe mandrel to the milling

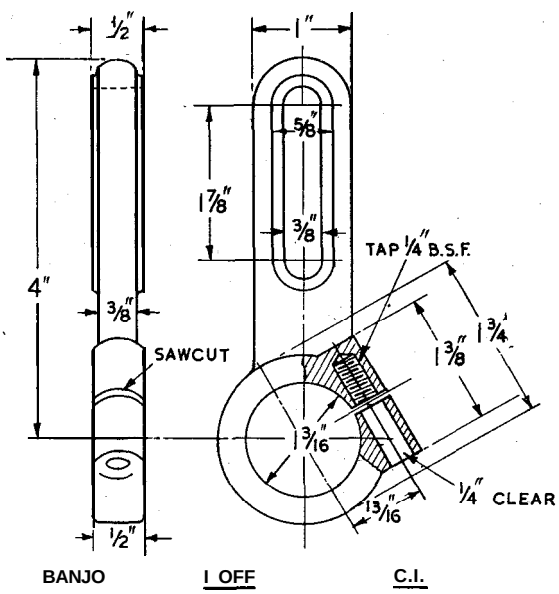


Details of components for milling and dividing appliance

appliance: the Morse taper socket allows either taper-shank standard arbors and cutters, or the patent Myford collets, to be used. A hole of appropriate size may be drilled right through the mandrel, to take a drawbar which will prevent slacking-off of arbors or cutters.

Whatever internal machining operations are carried out on the mandrel, it is extremely important that their concentric truth with the outer bearing surface should be preserved. Some constructors may prefer to carry out all external machining first, and then set up the mandrel, with the aid of a fixed steady on the outer end, for boring the Morse taper socket or collet seating. Another method is to carry out the boring operations first, and then mount the workpiece on a specially formed mandrel for external machining.

Details of thread and register dimensions for the mandrel nose will, of course, depend on the lathe to which the appliance is fitted. For the Myford ML7 or Super-7, the thread is 1-1/8in. dia. X 12 t.p.i., and the register is 1-1/4in. dia. The threads at the outer end of the mandrel, 7/8 in. and 5/8 in. dia., are both specified as 24 t.p.i., as this is a convenient pitch, eliminating any picking-up difficulties. But if you have dies and taps for other fine threads, such as brass pipe standard (26 t.p.i.), you may use them. The bearing surface of the mandrel must be dead smooth and parallel; it may be finished by the use of a ring lap. A key of suitable size for locating the lathe change wheels used for indexing may be fitted to a keyway cut bv end-milling as shown, or by a side mill or Woodruffe cutter.



BANJO I OFF C.I.

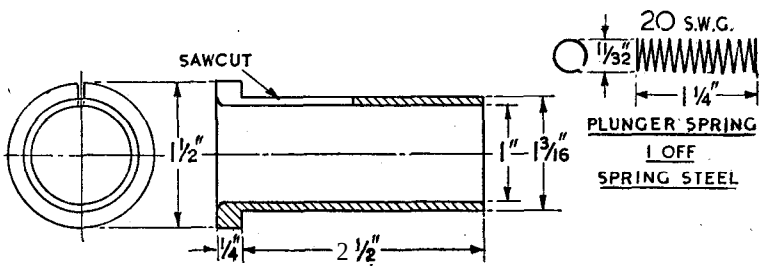
The collars for end-clearance adjustment of the mandrel may be machined in one piece, including the milling of the notches in the outer edge, and finally parted off. It is important that no burrs should be left to interfere with the true seating of the faces. Instead of notches, holes for a tommy bar or pin-spanner may be used. So that the mandrel and its bearing assembly can be withdrawn from the quill housing without affecting adjustment, the collars cannot be made larger in diameter than the bore of the housing; it is therefore difficult to apply other methods of adjustment, such as a single split-clamped or grubscrewed collar.

A casting with allowance for chucking at the large end will permit both external and internal machining of the sleeve bearing to be carried out at one setting. The bore should be' finished to a smooth running fit for the mandrel , and the outside to a close fit in the bore of the quill housing. I recommend lapping for final fitting. After parting off, facing the end, and forming a radius or chamfer in the mouth of the bore, to clear the fillet on the shoulder of the mandrel, make a sawcut about halfway along the sleeve from the large end. You can then firmly lock the mandrel against rotation by clamping the sleeve in the quill. Slackening the setscrew of the quill at this end allows the mandrel to be turned, while the sleeve is still firmly held against rotation by the other setscrew.

Making the fittings

The banjo casting is set up on the faceplate for boring, and facing the clamp end; this should be a close fit on the tail end of the bearing sleeve. After drilling and tapping the hole for the clamp screw, and spot facing the outer end of the lug, make a radial sawcut. The slot in the arm of the banjo is cast-in but, will call for some trimming, to allow the stud of the plunger housing to slide in it. Facing of the sides to a true parallel surface may be carried out while the casting is set up for boring, or by clamping it on a mandrel afterwards. When the banjo is fitted to the sleeve, only moderate tightening of the clamp screw should -be required to fix it immovably, while loosening it allows it to be adjusted to the most convenient angle for indexing.

A plunger with the end shaped to form a detent, to engage



SLEEVE BEARING I OFF G.M.

the teeth of any gear wheels employed for indexing, is carried in a housing machined from mild steel or other convenient material. The bore in which the plunger slides must be parallel with the surface which bears against the side of the banjo. It must be dead smooth and parallel. I recommend a D-bit for finishing it. This surface and the surface of the plunger may both be fitted by lapping. While the plunger must slide freely, no slackness can be tolerated if accuracy of indexing is expected. If you are clever enough to fit the plunger so neatly that air is compressed, so much the better-you can easily drill a hole in the housing to release the air !

Both ends of the housing are turned concentric with the bore, 1/2 in. diameter for a distance of 3/8 in. At the outer end, a cross slot is cut, 1/16 in. wide, in one side only. The base surface of the housing is drilled and tapped squarely to take a 3/8in. BSF double-ended stud with a central collar 3/4 in. diameter. After this has been tightly screwed in position, the sides are milled or filed away to a width of 3/8 in., to fit the slot in the banjo. If you prefer, you may machine the housing in one piece with an extension to take the place of the separate stud-taking care to face the seating surface truly, so that it beds flat against the banjo.

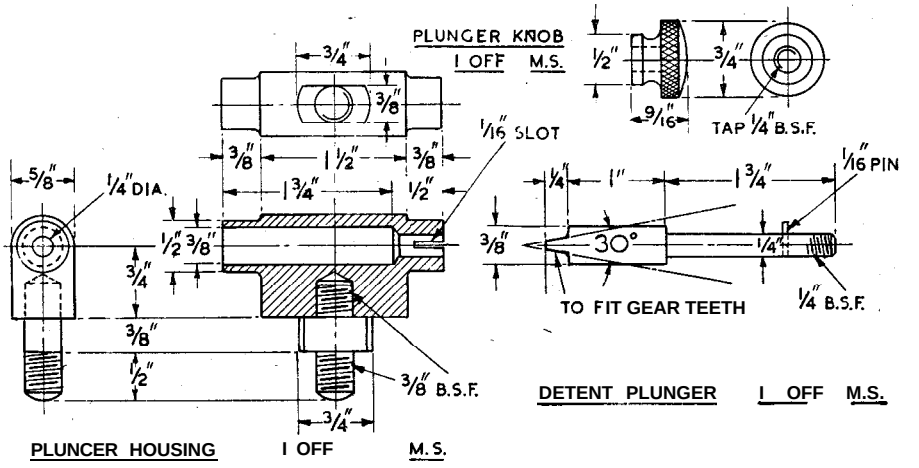
The plunger may be made of 3/8 in. bright steel bar, so long as it is chucked truly for turning down the end to 1/4 in. dia., and threading 1/4 in. BSF, At the other end, it is filed or machined to fit closely between the teeth of the indexing gear wheels. As the exact profile of the tooth spaces varies with the diameter and number of teeth, a universal form-fitting profile cannot be employed. A straight-sided detent at an included angle of 30 degrees will make good line contact with the teeth of wheels of all the sizes likely to be employed; and it has a good wedging action for positive location. The detent may be filed to shape if great care is taken to maintain symmetry and correct angle on the two sides, but you can get more positive accuracy by machining the angular surfaces.

To machine them easily, make the plunger with a small central witness projection on the end, of a diameter equal to that of the bottom of the tooth space. It is fitted in the housing; and held firmly in position by a nut **on the** end, and an internal sleeve of such length that the detent projects about 38 in. The housing is then mounted on the faceplate, by its fixing stud, in a radial position, with the detent pointing outwards. By swivelling the topslide of the lathe to **15** degrees from the cross centre, you can machine away one side of the detent until the tool just skims the witness projection. The topslide is then swung to the reverse angle, and the process is repeated on the other side of the detent. Only very light cuts should be taken, to avoid heavy intermittent load, but the process is by no means long or tedious.

side milling method

A somewhat quicker method is to mount the plunger in the toolpost, using a split clamp or V packing block which will locate it at approximate centre height. It is set exactly square with the lathe axis, while the swivelling topslide is at zero; then by swinging it **15** degrees each way in turn, you can machine the sides of the detent by a side milling cutter running in the lathe. The witness may be faced off, leaving the end of the detent just wide enough to prevent bottoming in the gear teeth. Symmetry of the wedge surfaces is highly important if the plunger is free to engage either way round; otherwise it is not critical. Some indexing devices have been made with the detent deliberately offset so that they can be used to "split a tooth "-to produce **120** divisions from a 6o-tooth wheel, for instance. They call for meticulous accuracy in the amount of offset, and can be used only with a single size of indexing wheel.

The detent may be case-hardened, but the rest of the plunger should be left soft. A spring of the size shown in the drawing will provide just about sufficient pressure on the plunger for positive indexing. Where abnormal side torque load is encountered, clamp the mandrel after indexing in each- position. After the indexing gear is assembled, and a gear wheel set up with the detent in proper engagement, a cross hole may be drilled in the shank of the plunger to take a 1/16 in. pin, just clear of the bottom of the slot. The pin may be either a drive fit or screwed in; its duty is light, as it serves only to locate the detent square with the gear tooth. When the plunger is withdrawn and partly turned, the pin will then hold the detent out of engagement and leave the mandrel free. The latitude allowed in the slot of the banjo permits the plunger housing to be adjusted for any lathe change wheel in the range normally supplied, and it may be extended to take larger wheels. It is generally best to use the larger wheels, when you have a choice, as they give greater angular accuracy and torque resistance.



You will find this form of plunger and housing assembly equally useful for indexing the lathe mandrel, if you set it up on the screwcutting gear quadrant or another suitable fitting. Nearly all lathe users have a need for some kind of indexing gear. It is often a crude makeshift, rigged up hastily, and subject to incidental errors. By taking a little time you can construct a sound indexing device which is just as simple to rig up, and far more reliable in accuracy.

The indexing gear is suitable for many operations in normal model practice, such as cutting small spur, worm and ratchet wheels, fluting taps, reamers and milling cutters and cutting squares, hexagons and keyways. In all these operations, the full power of the lathe, and its range of speeds, are used, and no auxiliary drives are required. The indexing spindle is quickly set up in the housing, with the banjo clamped to the bearing and a suitable change wheel mounted on the mandrel. When these things are not required, you need only remove them, and slip the mandrel assembly out of the housing without disturbing its end clearance adjustment. It is equally simple to replace the assembly with a quill-fitted milling or grinding spindle.

For some operations involving indexing or milling appliances, you must swivel the mandrel to various angles other than horizontal. My next instalment will describe an improved swivelling form of quill housing which allows this to be done and also provides for the fitting of an overarm support to steady the end of an arbor.

To be continued