A NEW KEYWAY SLOTTING ATTACHMENT

by Arnold Throp

Part II

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Ram. Fig. 11

Set the steel for the ram to run as true as possible In a four-jaw chuck and fix up a three-point or four-point steady to support the other end. There is a problem getting the fingers of a steady set equidistant from the imaginary line in space joining the lathe centres. and it has for a long time been a matter of juggling. or using a centred mandrel to get them as neat- as possible.

If they are much out of place the workpiece will tend to “walk” itself out of the chuck. What is thought to be a new appliance to overcome this difficulty has been devised and may be the subject of a short article in the near future. However, assuming that the steady has been fixed so that it looks all right, set the bar to run dead true at the chuck end. face the end of the bar, centre with a vee D-bit and drill about 3/16 in. for the depth of the tool holder.

Open out to 21/64 in. or 11/32 in., then bore with a small boring tool to make sure the bore is truly co-axial. Leave just enough for a 3/8 in. reamer to take out a scrape for sizing. Reverse the piece, face the second end, drill and tap 3/8 BSF. Do no more till the collar is fitted.

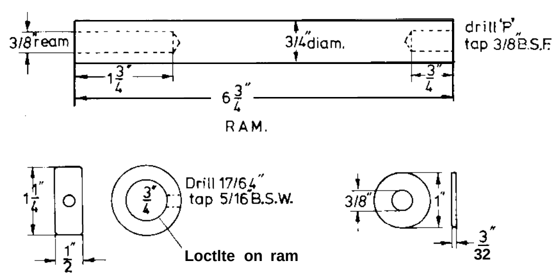


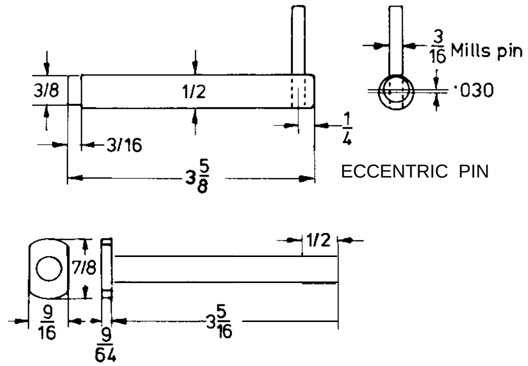
FIG.11

Collar. Fig. I I

This is a simple turning job, facing one side in the three-jaw chuck, drilling and boring out in stages to 3/4 in. to be a close fit on the ram. Ideally it could be a press fit, but the problem is to find a press in which it can be pushed on! It needs a very large vice to open out far enough for this length, and few modellers will even have access to one.

So. make the bore so that the ram will just enter. If it is a bit tight it can be knocked on with a hammer. using, a hardwood block to protect it. But if you go a bit oversize don’t worry. clean it up with one of the detergents and fix it with Loctite.

The whole purpose of the collar is to provide a reasonable amount of thread for the cutter bar locking screw. But don’t drill the hole for the screw at this stage. it is vital that this should be on the centre line as it will locate the cutters, and it needs doing in the lathe when the equipment has been assembled.

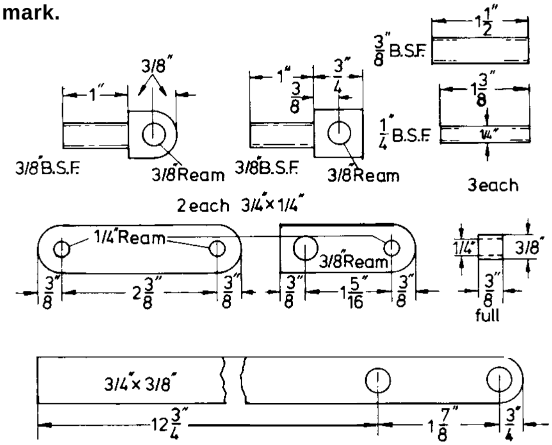


BOLTS 2off FIG. 12

Eccentric pin. Fig. 12

The eccentric pin is another simple turning job, using the four-jaw chuck to throw the piece out to get the end eccentric by the amount necessary for the taper in model keyways.

If two of the jaws are set equally from the centre (or the outside) and the displacement is obtained from the other two, a light touch with a tool should come exactly against one jaw. Set a scribing block point exactly to centre height and mark a line across the end to show where the axis of the eccentricity lies. Then, when the turning is finished, the hole for the Mills pin can be drilled in line with this mark.



HAND LEVER AND LINK FITTINGS

FIG. 13

File a flat where the drill has to start and check it on a hit of wrap to ensure it is not cutting oversize. Drill 3/16 in. and drive in the Mills pin.

Hand lever and link fittings. Fig. I3

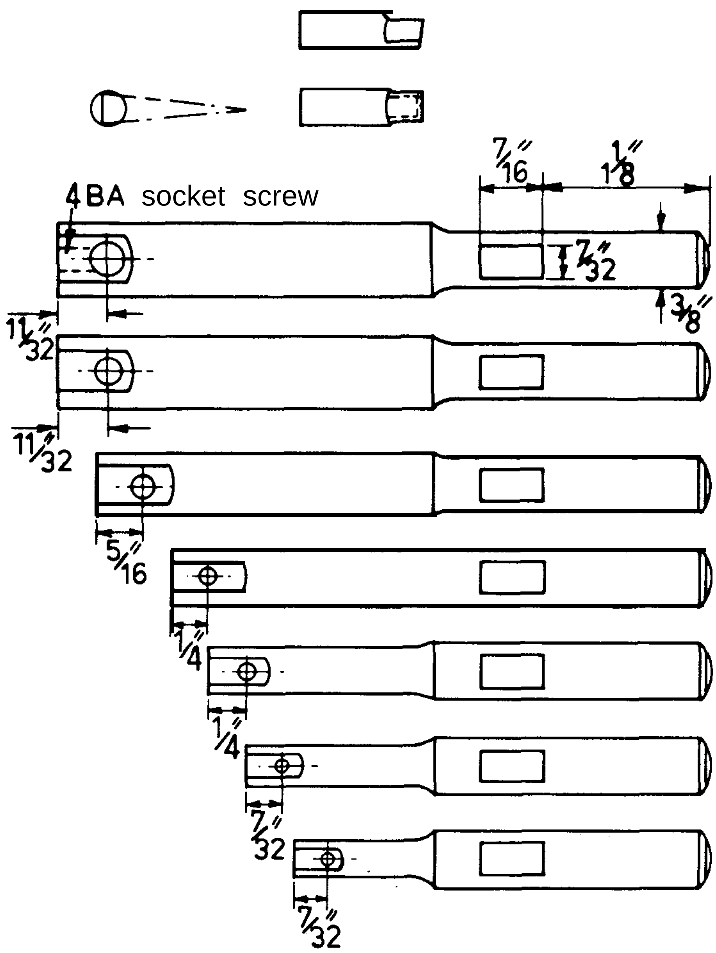
The hand lever is a very simple piece and so are the round ended fittings. Those for the ram and the anchorage point are just turned out of 3/4 in. by 3/8 in. flat bright steel. The hinge pins and bushes have been arranged for the easiest of construction. the one point of note being that the bushes must he a little more than 3/8 in. long to prevent binding between the lever and the links.

The big washer to go on the ram is just to provide a limit to the movement when the cutting tool goes through the hole when cutting a keyway. I have found it an advantage to put a rubber ring at each end of the ram. Black 0 rings are suitable for this as the buffer effect takes the jolt out of the lever.

Cutter bars and tool bits. Fig. I3

It used to he an accepted practice in full-size engineering, years ago, to make a key one quarter the shaft diameter in width. Following this for models gives keys varying from I/I6 in. wide in a

Shaft diameter									
		1/4″ 5/16″	3/8″	7/16″	1/2″	5/8″	3/4″	7/8″	1″
Key width	1/16″	5/64″	3/32″	7/64″	1/8″	5/32″	3/16″	7/32″	1/4″
Keyway depth	·032″	●	039* ●	0479	·055″ ●	062″	·077″	·093″	·110″ ·125″



BODY diam.	BODY length	TOOL diam.
1/2″	2 1/2″	1/4″
1/2″	2 1/2″	3/16″
13/32″	2 1/4″	5/32″
3/8″	1 3/4″	1/8″
5/16″	1 1/2″	1/8″
·288″	1 1/4″	3/32″
·225″	15/16″	3/32″

Fig. 14 CUTTER BARS

l/4 in. shaft to l/4 in. wide in a l in. shaft. Although the larger full-size keys were usually only about two-thirds of the width in thickness it is better in models to use square keys. Then the keyway, measured from the crest of the shaft is a depth equal to half the width. Deducting this from the bore size gives a figure which roughly represents the diameter of cutter bar which can be used when the cutting is just starting.

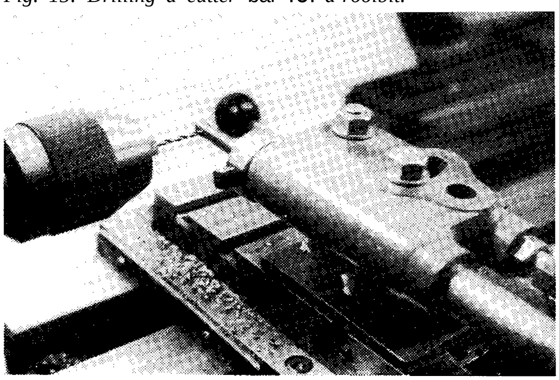
Actually, this figure is a bit too much, as the tool bit will have to project from the bar a little more than the theoretical half key thickness. The drawing of the cutter bars, Fig. 14, gives the diameters for the range l/4 in. to 1 in. bore, with suggested lengths.

Because all these cutter bars are of small diameter relative to their length they will be "springy" so they should be kept as short as reasonable, having regard to being long enough to reach through the bores. But I have tested both the smallest and that with the l/4 in. wide cutter on steel, and they work perfectly well, so there need be no doubts about working to these sizes. Of course, no size of cutter bar need be made until a job turns up which demands it, though no doubt some people will make several, once started and in the mood to do it.

Each cutter bar needs the cross hole for the tool bit drilling in the lathe with the whole appliance fixed on the boring table, as in Fig. 15. If a flat is filed on the bar the cross hole should go through centrally, and this is very important for the setting of the tool bit later. They are very small to hold in the fingers in dangerous proximity to a grinding wheel, so a dummy holder should be made for each size, though it can have a different size each end, and the actual diameter is not very important.

The purpose of the dummy holder is merely to hold the bit securely while grinding, and keep the fingers from being ground. In use, first grind a flat that is wide enough for the intended keyway. Then, turning the holder approximately 90 deg., grind a flat until a micrometer reading shows the appropriate amount to have been removed. Check all the

Fig. 15: Drilling a cutter bar for *a roolbit.*



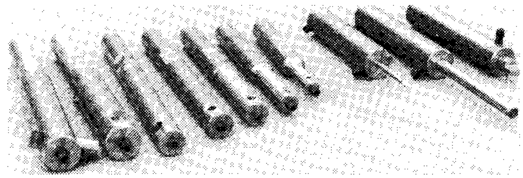


Fig. 16: Collection of curter bars cznd too/bit holders.

time to see that a little, but not excessive. side clearance is being made.

For example, making a 3/32 in. cutter out of l/g in. dia. steel, the amount to take off the first side will be .O I5 leaving .I IO, then taking the work to the other side of the wheel and removing another ,015. finishing at ,093. If this is done properly the cutting part of the bit will be central with the still remaining cylindrical part, and when mounted will be equally above and below the lathe centre height, and the right attitude in the bore.

Those who have the Quorn grinder will at once see how a tool bit of this kind can be made on that machine with the clearance angles under mechanical control.

It is a good thing to use high-speed steel for these small bits, even though the speed of cutting is so low. The steel, purchased as "hardened drill rod", i.e. twist drill blanks which have not had the flutes ground in, and obtainable from good tool stores, will have had perfect heat treatment and will keep its edge better, even though trailing on the return stroke in the slotting operation. To get a short piece it can be nicked on the corner of a grinding wheel and broken off in the vice. Fig. I6 shows a collection of cutter bars and holders, some with tool bits in place.

Holding down bolts. Fig. I2

Bolts made specially are really advisable for this equipment, and can be readily made from 718 in. dia. bright mild steel. All the sizes are given in the drawings. Keep them for this duty, in the block itself, and they will never be damaged or need to be searched for.

Operating the equipment

First of all it is essential that tool bits be kept sharp. As the tool is overhanging a long way from its support, on a relatively thin bar even in the larger sizes, it tends to "push off' from the surface to be cut. Bring the tool up carefull yto the place where-it starts cutting, with the saddle locked on the bed, then feed evenly and regularly with the cross slide screw, using the micrometer dial all the time.

If you go too greedily the tool will strike the end face of the work and refuse to enter. If that happens slack back and make a fresh approach.

I find that a feed of half a thou at each stroke produces good results and any more brings this danger of jamming on the end of the workpiece. This sounds a very small feed, but there is not far to go, and the time consumed is only a few minutes. No great price to pay for a quality product! At the finish make a few strokes with no feed at all to reduce the "push off".

At the start, of course, it is necessary to set the block according to the type of keyway required. Due to considerations of what diameters have to be strictly concentric with one another, a component having the need of a tapered keyway may well have the large end of the keyway towards the tailstock, or the other way. So the block must be set over to suit this. For components which need no taper the indicating pin on the eccentric needs only to be placed in line with the lathe bed. For those components with a tapered bore the block needs to be set over by means of a protractor as shown in Fig. 3, though the taper may need to be the other way to this illustration. (See *M.E.* 1 December).

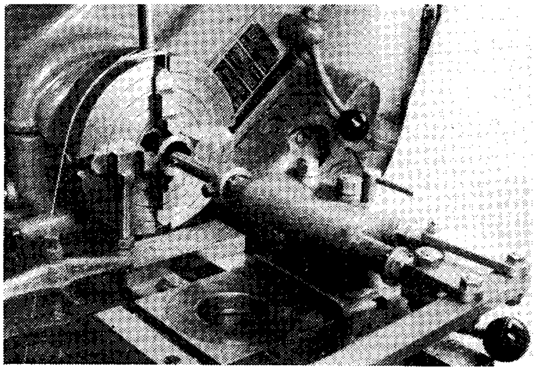


Fig. 17: *Cutting two keyways in one piece.*

It is always advisable to cut the keyway without re-chucking a component, and the ease with which this attachment may be put on the lathe and taken off again makes it unnecessary to do otherwise.

If there are two or four keyways to be cut in one bore, arrange to do the turning in a four-jaw chuck. Then you can put a packing such as a metal block, a piece of wood, or a bolt, under one jaw while the first keyway is done, move the work round to the next or next-but-one jaw, pack again and do the second keyway, in effect using the chuck as a dividing head. Fig. 17 shows this method in use on a two-keyway bore.

The position of the work was maintained by a piece of string round the chuck key, with a weight attached, and a bolt set to the right length on a bit of flat bar clamped on the lathe bed. These keyways were 1/4 in. wide in a steel collar. Fig. 18 shows a close-up of cutting a 1/16 in. keyway in a 1/4 in.

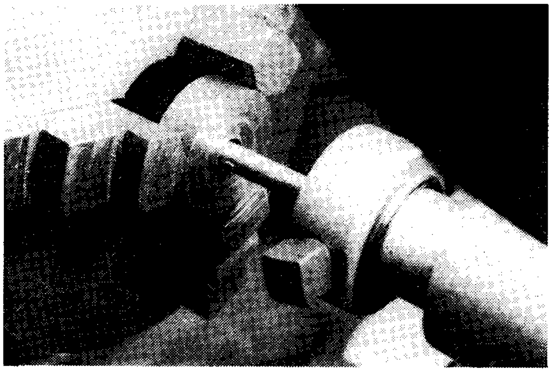


Fig. 18: Cutting a 1/16 in. keyway in a 1/16 in. bore.

bore in steel. using a cutter bar only ,205 in. diameter.

The use of the attachment is not limited to the cutting of keyways. Filing out square holes from drilled round holes is always a bit tedious. and for people not very competent with a file it is difficult to get a good result. With this attachment, however, the task is quite simple.

One needs a tool-bit of D-shape, the same diameter as the drilled hole, and a cutter bar with a co-axial hole in the end to suit it. When cutting starts, the tool-bit occupies just half the hole, and as one feeds it forward, reciprocating the ram, it cuts a flat around the round hole.

After feeding the correct amount of half the hole diameter, the tool is withdrawn, the work indexed 180 deg., and another cut taken, then another with 90 deg. indexing, and a final one 180 deg. from that. The set-up for this operation is shown in Fig. 19. where a 1/4 in. square hole has been formed in a return crank blank for a locomotive. The method can be used also for square holes in regulator handles, valve handwheels, etc.

Hexagonal holes can be produced in the same way by using the three-jaw chuck and packing under the jaws first at the front and then at the back, to get the 60 deg. spacing.

Fig. 19: Cutting a square hole in a loco return crank.