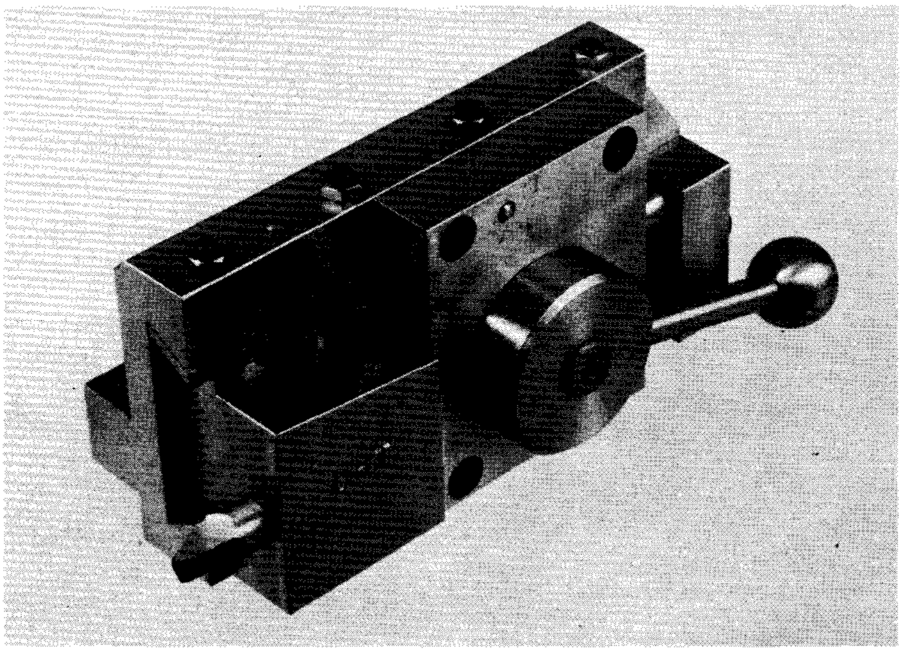
A RETRACTING TOOLHOLDER FOR SCREWCUTTING

by Geo. H. Thomas

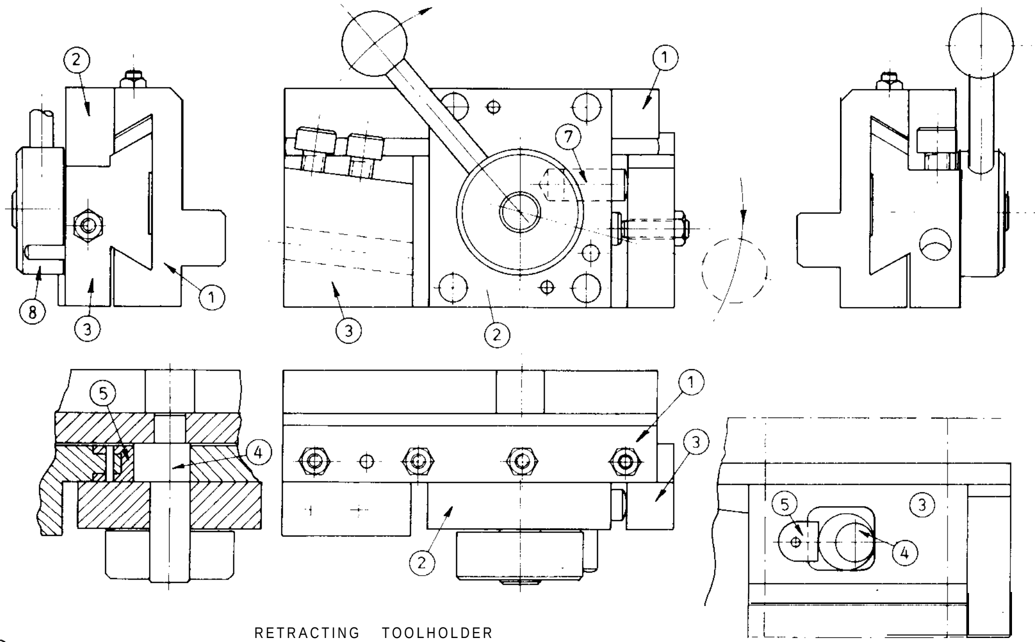


Part I

A **FEW YEARS AGO I** wrote a brief description of two of the ways in which a screwcutting tool can be drawn quickly out of cut and subsequently returned exactly to the original position (See ***Model Engineer No. 3570,*** Oct 7th 1977). The first of these is a self-contained toolholder adapted to be clamped in a square turret and is the subject of this article. After completing this toolholder, for reasons which will be given at a later date, some major alterations were made to the top-slide feed-screw arrangements and these pointed the way to a new design for a quick retracting top-slide having an inbuilt withdrawing mechanism. A description of this together with full constructional details will form the subject of a later article and it might be opportune to mention at this point that whereas the retracting toolholder can be used for external screwcutting, the retracting top-slide will handle either external or internal threads with equal facility.

This retracting holder can be used for either of the two principal screwcutting methods, namely, (a) the simple plunge cut in which the tool cuts equally on both sides, the toolholder being set square-on to the work and the top-slide parallel to the lathe axis and locked. Feed is put on by the cross-slide and the tool taken out of cut and returned by means of the toolholder without disturbing the settings. This is probably the most generally used method and is satisfactory for fine threads but it does have certain drawbacks in that no rake can be applied to the cutting edges of the tool and, if the top-slide is set parallel to the lathe axis, the right hand end of it is likely to foul the tailstock when cutting small diameter threads between centres but this latter trouble can always be overcome by swinging the top-slide through a small angle which will not affect the screwcutting operation as it does not have to be used.

In the other method (b) which is very desirable for coarse pitches, worms etc. — especially in steel — the tool is fed down the flank of the thread so that only the leading edge is cutting. This makes possible the use of a positive rake on the cutting edge and although it is not a very large angle, it does help to prevent tearing when taking the initial cuts which are usually much deeper than the finishing cuts. The top-slide is swung round through 90 deg. less half the thread angle so, for Whit. form threads having an included angle of 55 deg. we have to turn the top-slide through 90 − 27% = 62½ deg. for R/H threads. For L/H threads we must turn the top-slide through 90 + 27% = 117% deg. so that the slide movement is slightly towards the tailstock. The tur-



© RETRACTING TOOLHOLDER

Fig 1

ret is set square in relation to the lathe axis by sighting the forward edge against a T-slot in the boring table which is a far more accurate method than all the screwcutting gauges. My usual procedure is to set the top-slide thimble to zero; feed the cross-slide forwards until the tool just touches the work and then lock it. Cuts are put on by the top-slide and the tool withdrawn after the cut and returned again by the retracting holder.

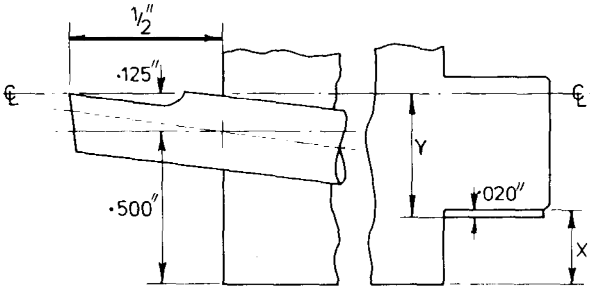
The amount of feed applied to the top-slide will have to be rather more than the nominal depth of thread; the exact amount is obtained by multiplying the true depth by the secant of half the angle which, for all practical purposes, is one and one-eighth for 55 deg. and 60 deg. threads so one has only to increase the depth of cut by one-eighth e.g. 16 t.p.i. has a depth of 40 thou and adding one-eighth will increase it to 45 thou. This subject was covered in some detail in the article which appeared on 15/8/80 & 519180; Vol 146, pp 994 & 1056.

As will be seen from the G.A. drawing (Fig. 1), the holder consists of a main body (2.1) having a dovetail groove along one face and a tongue at the back which fits into the tool slot of a square turret. This body carries the moving tool slide (3.3) which is provided with a dovetail portion to slide in the main body. A rectangular hole through the slide houses the eccentric and a hardened pressure pad. The camshaft is provided with bearings on both sides of the eccentric portion — one in the main block and the other in a bridge-piece (2.2) which is screwed and dowelled to the body. This bridge, which is completely clear of the tool slide, houses a spring plunger (3.7) acting on the tail end of the slide which, in turn, is provided with a 4 BA stop screw acting as a positive limit stop for movement in a forward direction.

The tool is held in the slide at an angle of 7 deg. to the horizontal which gives an acceptable amount of back rake to a flat topped tool. This angle must be added to the front clearance when grinding the tool. The forward (operating) position is reached when the cam is on dead centre at which point the 4 BA stop screw will be firmly in contact with the hardened stop button (3.6) The cam is case-hardened and co-acts with a hardened pressure pad (3.5) which, in my case, is slotted and fitted into milled recesses and riveted into place with a $\frac{1}{16}$ in. pin. I would agree that this construction calls for some rather exacting work and that the same end could probably be attained more easily by fixing a small hardened plate on the face of the aperture with Araldite. See sketch of alternative construction in Fig. I.

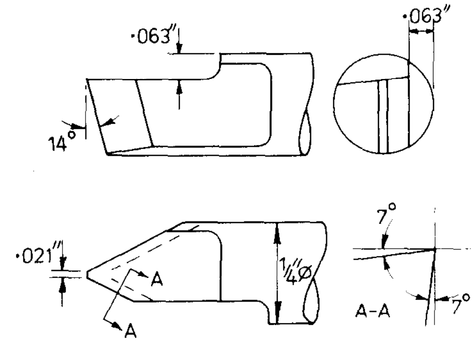
The spring-loaded plunger (7) assists the tool to retract so that one needs only to flick the ball handle with a finger to obtain instant withdrawal of $\frac{1}{8}$ in. — approximately the depth of 5 t.p.i. Whit. form. Although the holder is small and compact, the tool is held and guided rigidly without a trace of spring or deflection under cut and after 12 years of use there is no sign of wear — in fact, the parts look as though they have never been used. The compactness of design is due, in a large measure, to the use of round HSS tool bits which, for reasons that will be given later, I have used for screwcutting for many years.

It will be seen on the drawing of part 1 that the dimension from the bottom of the body to the underside of the tongue by which the tool is gripped in the turret is shown as "X" and this calls for an



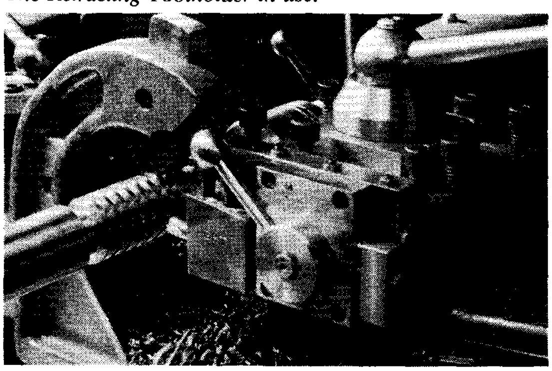
'Y' = height from floor of turret tool slot to ℄
'X' = ·625" − Y + ·020"

© Fig 5



Tool for 8tpi whit R/H

explanation before we attempt to make the component. The design of the tool is such that when it is fitted into my square turret, resting on a packing strip .020 in. thick, the tip of one of my "standard" form ¼ in. dia. screwcutting tools will be exactly on centre line when it is standing out ½ in. from the front face of the holder — see Fig. 5 which shows also one of the ¼ in. dia. tools. The height from the floor of a tool slot in the turret to the centre line of the lathe is indicated as "Y" in the drawing and in my case this is .332 in. (See article Lathe Tool Turrets, ***Model Engineer 4*** Mar '77, p. 251).



The Retracting Toolholder in use.

Making the simple calculation indicated on Fig. 5 we have: X = .625 − .332 + .020 in. equals .313 in. which is correct for my lathe and equipment but anyone making this toolholder will have to make his own check. If a height-gauge is available, the height from the bed to the tool slot is easily measured and the centre height of the lathe determined from the dimension to the top of the tailstock barrel minus half of the barrel diameter. One should obtain all such information and record it in a workshop notebook.

The height of the tool tip can be adjusted in various ways: by reducing or adding to the .020 in. packing strip; by altering the extension of the tool or by changing the .063 in. dimension at the top of the tool but one should aim to have everything come out according to plan.

The work involved in making the toolholder is largely good-class milling for which the ideal equipment is a vertical milling machine but I have no doubt that some of our more gifted readers would be quite capable of carrying out the work on a lathe with vertical slide. One essential piece of equipment is a really good machine vice and, to go with it, an assortment of parallels such as the set 1 described in the series "Setting up Aids" ***(Model Engineer No. 3568).***

STOP PRESS. When this article was almost ready for dispatch I learned of the first RTH to be made by a reader of ***Model Engineer.*** Mr. A. Craven of Clwyd, to whom I sent copies of the drawings some time ago, tells me that he has successfully made the toolholder using only a Myford Super-7 lathe and vertical slide. To suit his preferred manner of working he made one modification by omitting the tongue and making the body of angle form which provides a foot for direct mounting on the top-slide after removal of the square turret.

One of the most difficult problems encountered with work which is wide in relation to its height, is the tendency for the side in contact with the moving vice-jaw to lift when the vice is tightened. One usually has recourse to a rubbber-faced hammer to beat the work down on to its supporting parallels, both of which should be nipped by the work-piece. I regard this as one of the most unsatisfactory aspects of milling work and one which must be even more frustrating when the work is carried by a vertical slide because one cannot use heavy hammer blows in that situation. One other requirement is a 60 deg. × 1 in. dia. dovetail cutter which is the same one as is used for the precision boring head and the Radford type ball-turning tool. Dormer and Clarkson cutters have ½ in. dia. shanks, either plain or threaded 20 t.p.i.

When my own toolholder was made I had no intention of writing about it so any notes that I might have made have long since been destroyed. I shall give descriptions of one or more ways of going about the work but the process might depart in several respects from the one that I followed originally.

Constructional details of the Retracting Toolholder will commence in the next issue. **Continued**

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Part II

From *Page* 13.16

GIB STRIP (3.9). It might seem a little unorthodox but there arc good reasons for making this little part before we create the space into which it fits. It can be made from a piece of either 3/32 in. thick ground flat stock (gauge plate) or BMS. If the latter is used it will need to be made quite flat and true before attempting any machining on it. My favourite method of six brads — two on each side and one at each end — driven into a piece of flat hardwood is probably the most satisfactory way of holding down whilst draw-filing and touching up local spots until it blues uniformly on the surface plate. The work can be prised out from the enclosing brads with a penknife and snapped back again after testing. Only one face needs to be trued up in this manner.

The strip is next brought to width which is shown as .387 in. on the drawing — this being the calculated dimension to the comers — but .375 in. to .380 in. would be perfectly satisfactory. The simplest way to bevel the two edges is to set the piece up in the vice. across the table, and then cut the 30 deg. bevels with an endmill in the vertical head which has been swung round through the angle. If the strip is prepared to a width to .375 in. a VERY small witness could be left at each corner after milling the bevels. It will be pratically impossible to measure the reference dimension of .290 in. but it MUST be a trifle under .300 in. or it will foul the underside of the bridge (2.2). The strip can now be cut to length and the best way to finish the ends is to round them off a little. leaving them looking rather like the spine of a book.

Any piece of work that calls for a number of machining operations to be carried out should first be examined in order to decide on the most suitable datum surfaces i.e.. those surfaces from which all the important dimensions are taken and on which the work can be set down and located. Without working in this manner all the operations will be in the air — so to speak — and errors are likely to creep in from all directions. When the surfaces have been selected they should be machined to a good finish before anything else is done.

When the work has to be carried out on simple

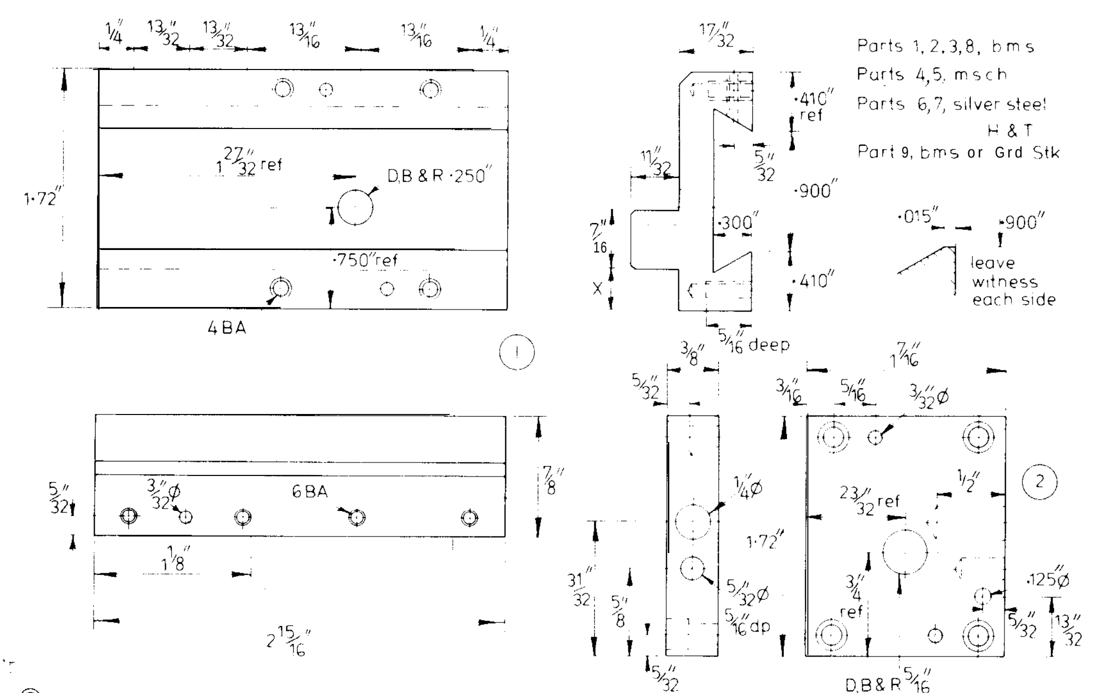

Fig 2

rectangular chunks of metal and is of a fairly complex and exacting nature, it pays to carry the datum surfaces further and to finish all surfaces flat and parallel or square to each other, using surface grinding if possible. To get the material to this stage is to have the work almost half done. These points might sound very elementary — they are — but it is surprising how many workers start a job in the middle, so to speak, and give no thought to proper planning.

THE BODY (2.1) is made from a piece of FCMS 1¾ in. by 1 in. which is best reduced to a full ⅞ in. thick and quite parallel. Fig. 4 shows diagrammatically the principal milling set-ups for this and the tool slide. The operations on the body are as follows: (A) Reduce the width to 1.72 in. by milling both edges and leave them quite parallel. (Al) Not shown. Square up the two ends, bringing the block to length, 2% in. (B) After scribing two lines at 15/32 in. and 1 7/32 in. from one edge, set up on parallels and mill the groove ¾ in. by .280 in. deep. This is only a roughing out operation to get rid of some metal and it might give rise to a little distortion which, at this stage, will not matter. The diagram indicates a light cut on the top surface but if the material has been properly prepared this cut can be omitted at this stage.

Before the next operation (C) we shall do a little marking out for the tongue, using the derived dimension "X". It should be gripped in the vice with ⅜ in. standing out above the vice jaws (not more). Now, using a reasonably large end mill, we cut the two rebates to a depth of .340 + .005 in. (the latter for a skim over the top of the tongue). Don't work to the scribed lines, they are there to save mistakes. Cut the small rebate first, locating the cutter against the edge of the material and then feeding in for the amount "X". The large rebate is cut next and to exactly the same depth and in this case we can work to the scribed line — check width of tongue with a micrometer, leaving it not more than 7/16 in.

For the next operation (D) we turn the work over and locate off the tops of the vice jaws which, in my case, are hardened steel inserts surface ground in place to bring the tops of the jaws parallel to the underside of the vice. It will be appreciated that the jaws have sharp corners which would prevent the work from seating down properly if there were any radius in the corners of the rebates. As there is certain to be a radius, however small, due to cutter wear, it might be desirable to interpose strips of thin card — say 10 thou thick — between the tops of the jaws and the work. Using a ½ in. or ⅝ in. end-mill, we widen and deepen the groove to the dimensions shown and then the end-mill is changed for a 60 deg. dovetail cutter which brings us to (E) where we complete the dovetail groove, leaving a small witness at each side of the .900 in. width as shown in the small diagram.

The cutter is best brought roughly central to the groove and passed straight through, taking approximately equal amounts off both sides. Subsequent cuts will be taken along each side with the bottom

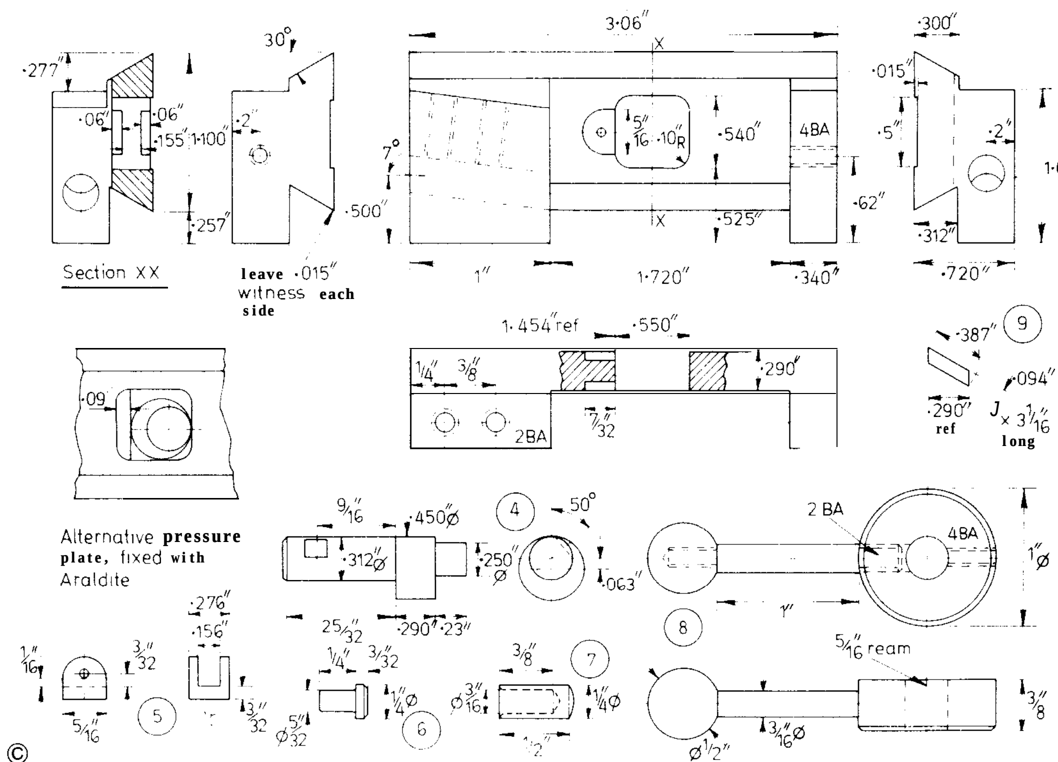

Fig 3

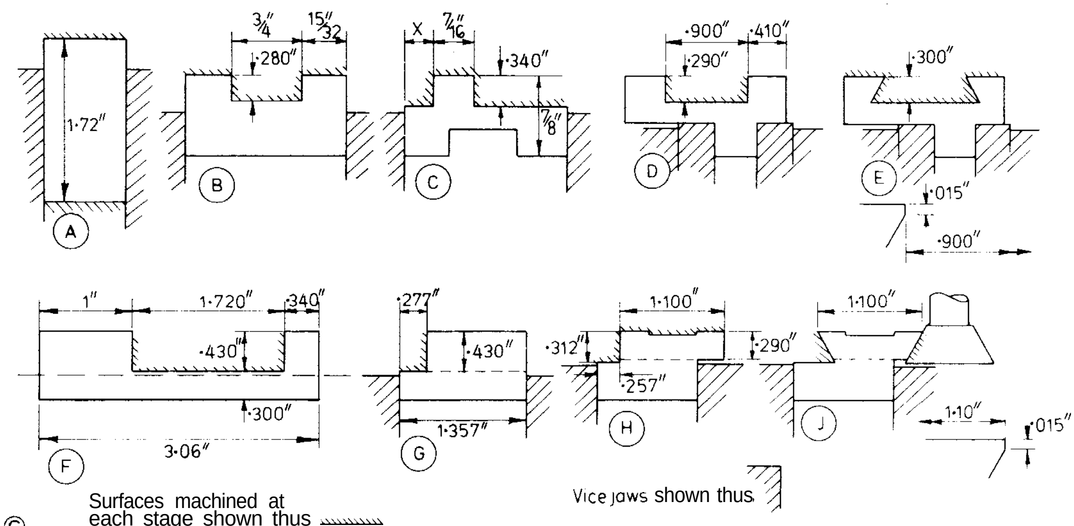

Fig 4

face of the cutter not quite touching the floor. Finish each angular side with one or two passes in each direction without adding any further cut and at a very fine rate of feed, When the sides are considered to be satisfactory the cutter can be lowered which will take it away from the sides and enable the bottom of the groove to be brought to a fine finish. On no account should one attempt to cut both the bottom and the angular sides at one pass because, as I have explained elsewhere, this will give rise to cutter flutter (sorry!) which will ruin the finish. The making of a similar 'dovetail slide was described in an article "Boring Heads" in *Model Engineer Nos. 3592 & 3593* in Sept. 1978. In view of the large number of the precision boring heads that has been made satisfactorily by following the instructions, it might be helpful to read pages 1083& 1084 Mol. 144. We have now completed, for the time being, the work on part 1 and need to make the tool-slide and bridge before carrying out further operations.

The TOOL-SLIDE (3.3) is made from a piece of FCMS 1% in. by ¾ in by **3** ⅛ in. long which is first milled to dimensions .730 in. thick by 1.357 in. wide and the two ends squared to length. The work can be set up in the vice on parallels as shown at (F) and endview at (G). This is the kind of job that tends to lift on one side and it might be preferable in this case to hold the work down on to the table with a couple of clamps on the ends at points where there is no machining to be done. Make sure, by clocking, that the block is lying quite parallel to the direction of table travel. At this setting we can cut out the large gap and the rebate to the same depth. When cutting the gap across the material be very careful, especially with the first pass through, or an expensive cutter might be ruined. (See "End Mills & 'Slot Drills", 1514177).

After completing the milling to (F) & (G), the block is turned over and gripped by the narrower part resting on parallels in such a manner that there is a gap of about .030 in. to .040 in. between the top of the vice jaw and the overhanging ledge — see (H). Still using the same cutter, we create the rebate to leave the top 1.100 in. wide and then form the shallow relief groove down the centre which should be cut .025 in. deep to allow for the .010 in. finishing cut on the top surfaces. This cut, which will bring the thickness down to ,290 in., would be best done with the lower face of the dovetail cutter *before* dealing with the angled sides as at (J). The milling of the angled edges is quite straightforward; cut the L/H side first after lowering the cutter until its face almost touches the flat bottom. At this height it will be just right for cutting the R/H side — as drawn. Once again we work to leave witnesses of about 15 thou.

If the dimensions have been adhered to it should now be possible to slide the main body over the dovetail and leave a gap at one side .094 in. wide which might accept the gib strip which, if made from 3/32 in. BMS, will probably be a trifle less. If the strip will not enter, it could be reduced a trifle by surface grinding or, alternatively another fine cut could be taken off that side where the cutter is shown at (J). The gib strip need not be sloppy but it must not be tight. The BRIDGE-PIECE (2.2) is the next part to tackle. It is made from BMS 1% in. by ⅜ in. by 1¾ in. long. The undersurface should be nice and flat and the edges square and parallel. Blue up and mark out all over. Drill the four corner holes tapping size only (3mm or No. 32) and keep to the marked dimensions, 5/32 in., from top and bottom edges. Drill the two holes for 3/32 in. dowels a few thou undersize — say No. 43. Mark the centre for the camshaft and drill the remaining odd holes. The 125 in. hole near the bottom R/H corner can be drilled undersize and partly opened with a hand reamer later on to provide a force fit for a ⅛ in. pin which acts as a stop for the handle, but do not fit yet. *Continued*

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Part III (Conclusion)

From Page 1407

The* Bridge Piece (2.2) *Continued

We next take up the body again and, on the top edge, mark out and drill all five holes 2.3 mm or No. 43, tapping four of them 6 BA for gib-strip screws. Apply the bridge to the face of the body 1 ⅛ in. from the front end and with the bottom edge exactly flush with the lower side of the body. Hold it in position with a couple of toolmaker's clamps and spot through for the dowels and the 4 BA screws. Remove the bridge and take the four screw holes down 7/16 in. and tap 5/16 in. deep full thread. Before tapping any hole, ***always*** open up the tops with a clearance drill to a depth of about one thread. Take the two dowel holes down to depth, first with No. 43 and then 3/32 in. Complete the holes in the, bridge by opening the screw holes to No. 27 and then counter-boring 5/32 in. deep for cap screws. A set of BA counter-bores makes an interesting little job for the Versatile Dividing Head.

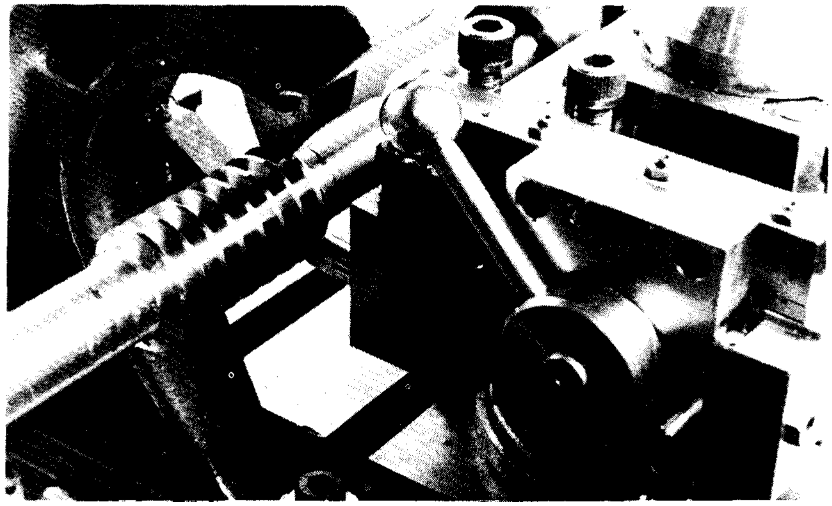
Prepare two dowels of 3/32 in. silver steel, ⅝ in. long and with a small chamfer on the bottom end and the top domed and polished. Carefully de-burr the under-face of the bridge after making very small countersinks where the dowels emerge from the face. Now open up these holes, from the front, with a 3/32 in. hand reamer but not right through. Leave the bottom of the holes tight so that the dowels are gripped firmly when they are driven in from the front. De-burr the faces of the body and offer up the bridge which should fit snugly on its dowels.

One important job remains to be done; the milling of the rectangular aperture in the tool-slide and boring the camshaft bearing holes which must, of course, be located accurately in relation to the aperture. There are many ways of going about this and I shall describe first the method that I think I might have used myself — it appears to be the simplest — but we must first finish the dovetail slide. Slip the tool-slide into the body and if the sharp edge of the lower vee touches in the comer, thus preventing the angular faces from coming into contact, it should be eased off a little by filing. Fit the gib strip and pinch up with the screws. We next carry the dowel hole down through the gib strip until the drill just enters into the slide. The dimple so formed serves no useful purpose but does no harm. The dowel should be made carefully with a 30 deg. slope on its bottom end which must enter well into the strip but not right through. If dog-end adjusting screws are used, one could make four ***small*** dimples in the gib strip by passing a No. 44 drill down each screw hole in turn.

If the milling operations have been well carried out it should be possible to adjust the screws to permit reasonably smooth sliding action. The finishing touch is given by smearing the working surfaces with a little fine-grade oilstone powder and oil and working the slide to and fro until all the contacting surfaces are a dull, uniform grey colour. The movement of the slide should be such that it extends alternately at each end for about one inch — one third of its length. If the milling is not up to the desired standard and there is noticeable ribbiness, it might be preferable to start with a medium grade of oilstone powder. After lapping, thoroughly wash out all the parts in paraffin.

The aperture in the slide and the camshaft holes will all be produced by working to rectangular co-ordinates — see Fig. 6. We shall start with the slide which can be clamped down on to two equal packing blocks, leaving a clear way through for the drills. The position of the opening will be established by drilling four holes correctly located in relation to the front and lower edges of the front block, using an edge-finder which I have already described (518177 & 19/8/77). The cutter will be 3/16 in. dia. and the aim when milling would be to form all four sides as tangents to the corner holes and this end would, I believe, be more easily achieved by making the drilled holes slightly larger than the cutter; the holes are, therefore, shown as .204 in. dia. (No. 6 drill) and the co-ordinates have been worked out accordingly. In view of the amount of breaking into and out of holes, it would be advisable to use a slot-drill rather than an end-mill.

Complete each corner hole in turn, using centre-drill, undersize drill and, finally, the No. 6. For this kind of work I always use stub drills which are less inclined to wander than the normal jobber's drills. It will be found helpful to set the table stops to limit the longitudinal travel which will enable one to concentrate on the cross movement. (Why are stops so rarely provided on the cross movement of milling machine tables?). Before disturbing the set-up it will be possible to measure the width and height of the opening (which should be .540 in. by .550 in. wide) by using either a telescopic hole gauge or the "inside" tips of a vernier slide-gauge. If the relevant parts have all been made exactly to the drawing dimensions, the front of the tool-slide in its forward position will be flush with the body and the bottoms of the two parts would be flush also. It will be seen in Fig. 6 that the two co-ordinates are taken, correctly, from the front and bottom of the body but in a less than perfect world these reference surfaces are not



The Retracting Toolholder in use, screwcutting a worm.

likely to agree exactly with those on the slide so it will be much safer to locate the camshaft bores from the same two reference surfaces as were **used** for the aperture in the slide. This can be done quite simply as follows: Assemble the slide and gib strip in the body and then fasten the bridge in place. Push the slide back against a No. 30 drill interposed between the front block of the slide and the bridge and then tighten all the gib screws. The drill will have established a gap of .128 in. to provide for the 1/8 in. withdrawal movement. The assembly can be gripped by the tongue in the machine vice as shown at (D) or (E) but with a 2 in. length of 7/16 in. or 1/2 in. square BMS between the jaw (the L/H one on the drawing) and the tongue. This piece of material enables one to drill right through with only one half a hole in the tongue.

We can now locate the camshaft bores from the same two reference surfaces as were used for putting in the four holes for the aperture, working with an edge-finder as before. After bringing the work into the correct position under the machine spindle and securely locking the table in both directions, we can lift the bridge, remove the tool-slide and drill, bore and ream the .250 in. hole in the body. The bridge can now be replaced for drilling and boring the 5/16 in. hole which can be finished to size with a machine reamer if available and if not, the hole should be bored to size and a hand reamer put through in the "Pillartool" (tapping machine).

There are several simple operations yet to be carried out on the two main components but before dealing with these it would be a good idea to make the camshaft and try it in place.

CAMSHAFT. (3.4) Grip a piece of 5/8 in. dia. FCMS in the chuck with 1 1/4 in. to 1% in. standing out. Turn the stem portion to .3 12 in. dia. for a full 25/32 in. length; chamfer the end. Leave a clean face at the shoulder and a ***very*** small radius in the corner. Part off at 17/32 in. beyond the shoulder. Grip the .312 in. dia. and turn the small end to dimensions, leaving the collar .290 in. long. Make up a bush from 1/2 in. dia. brass or BMS, 3/4 in. long and with a good 5/16 in. reamed hole. Cut a longitudinal slit with a hacksaw and remove the internal burrs with the corner of a square file. Use this bush to hold the camshaft in a 4-jaw chuck and set over to an eccentricity of .063 in. to .065 in. which is readily determined by using an ordinary plunger-type DTI which, when resting on the 5/8 in. dia. should give a reading of .126 in. to .130 in. Note that the indicator will not give a correct reading unless the axis of the plunger passes through the axis of the lathe centres — in other words it must be radial.

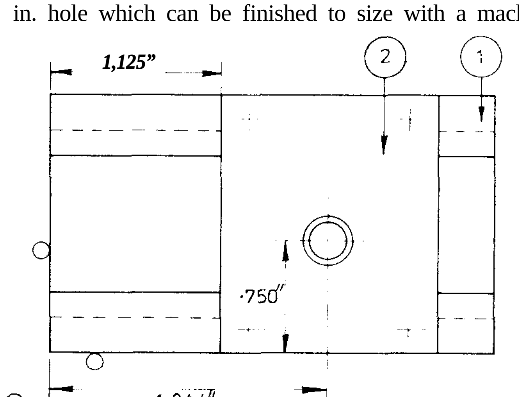
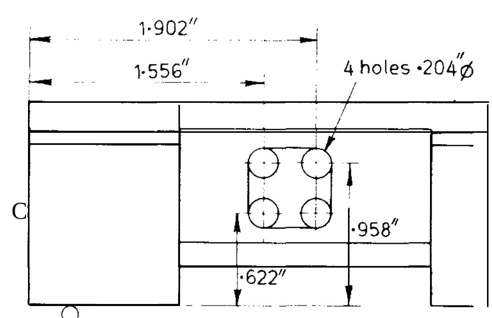


Fig 6



Because of their all-round usefulness, especially when working into holes and cramped spaces, the "Verdict" type of DTI has greatly increased in popularity over the past 20 or 30 years and many workers might not possess a plunger form but they will be able to use their "Verdict" as a null-point indicator. (I tend to refer to the lever operated indicator by the name "Verdict" which is a good British-made product but there are a few others — "Last Word" by Starrett (U.S.) and "Compac" of Geneva come to mind). The indicator should read zero (or any given number) at both the highest and lowest points, the cross-slide having been moved through the appropriate distance — .126 in. to .130 in. — between the two readings. When using this type of indicator it is important that the probe is set to touch the work at centre height. One can even work without any form of indicator by using an ordinary turning tool as a probe and a cigarette paper in place of the indicator; the amount of eccentricity will be read on the cross-slide. When the throw is satisfactory the collar can be turned down to .450 in. dia. and then, at its lowest point it should be four or five thou proud of the 5/16 in. stem. The position of the flat on the stem is best determined by marking with a cup-end grub screw on a trial assembly before case-hardening.

With the slide and gib-strip fitted, try the camshaft in the 1/4 in. hole. It should be able to make half a turn. Check that a piece of 3/32 in. material can be inserted between the cam and the pressure face and that there is a clearance above the cam when it is in its highest position. Ease any tight places. Do NOT tamper with the pressure face; if any easing is required, take a little off the opposite face.

PRESSURE PLATE. (3.5). If it is decided to use the forked pressure plate, like mine, it would be as well to make this before recessing the slide to receive it. The part is made complete on the end of a short length of 5/16 in. square BMS before cutting off with a slitting saw. If a note is made of the depth of the slot from the tip of the radius down to the bottom (nominally 5/32 in. + 1/16 in.), this dimension will be of use when setting the position of the slitting saw to leave 3/32 in. of metal at the face. Note that the 1/16 in. hole is not at the centre of the radius. The two round ended recesses are cut with a 5/16 in. slot drill in the centre of the height of the opening; file a little piece if 1/8 in. flat material to .114 in. thickness and use this as a feeler between the O/D of the cutter and the top of the hole on both sides. This part is case hardened after carefully fitting into place and the hole is transferred through the slide to take a 1/16 in. wire rivet.

The remaining jobs on the slide are very simple. The top of the front block is milled off at 7 deg. and the tool hole is carefully marked out, drilled and reamed 1/4 in. dia. There are also the tapped holes for the 2 BA cap-screws and the 4 BA hole for the stop screw.

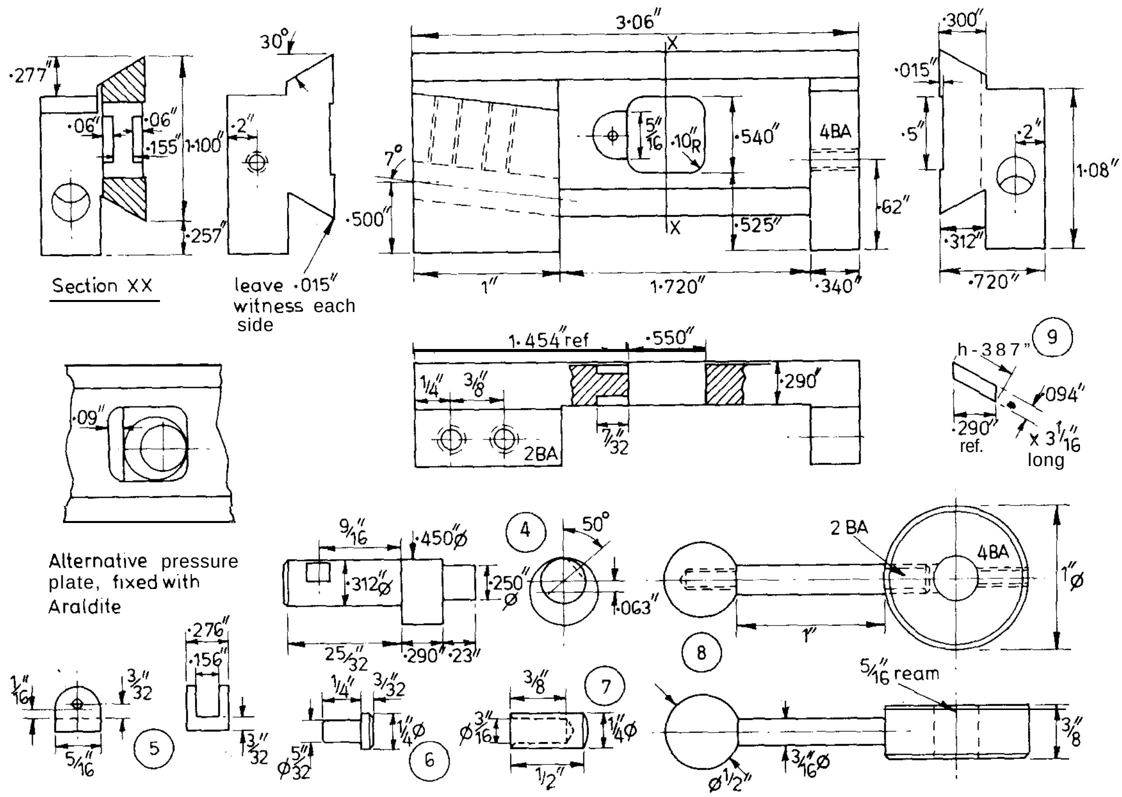


Fig. 3

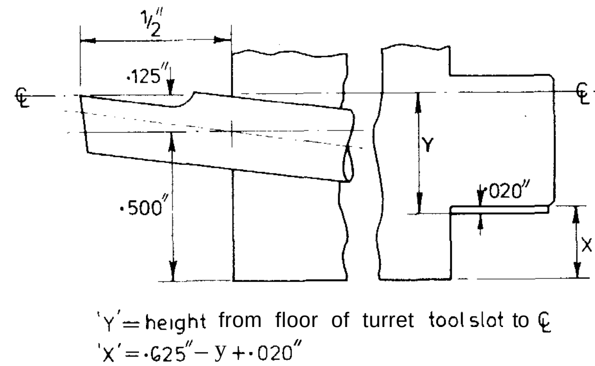


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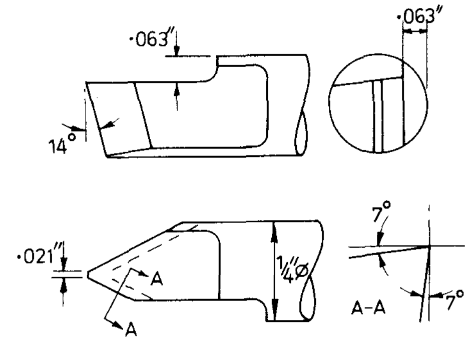
Fig 5



Tool for 8tpi whit R/H

The dimensions of the essential parts of the device are such that when the operating handle is pushed forwards as far as it will go — i.e. until the cam (eccentric) meets the bottom of the rectangular opening — the cam will be on "dead centre" in relation to the pressure pad. At this point the slide is as far forward as it can go and the end-stop screw should be so adjusted that it makes contact with the stop button the merest trifle before this point is reached. When it is set correctly the last very small movement of the handle will be noticeably harder. In this state, the whole mechanism is virtually locked solid. Provided that the parts are properly made and well adjusted, an upward flick on the handle, aided by the strong spring, will give an instantaneous withdrawal of the slide; the handle coming to rest against the stop pin in the bridge.

SPRING. As mentioned, the spring is quite strong — in its working position, compressed to a length of .53 in., it exerts a force of about 16 pounds (by calculation) which is a lot of spring force to pack into the small space available. I have been unable to find anything suitable in the stock spring lists so the following information is given to enable workers to make their own. It is wound from cold-drawn spring steel wire 20 SWG (.036 in. dia.) to give an O/D of .177 in. and I/D .105 in. It has 13 coils and a free length of 13/16 in. The correct diameter was obtained by winding on to a 3/32 in. dia. silver steel mandrel. Unfortunately, when the 4 in. s.c. chuck was closed down to 3/32 in., there was insufficient space between the jaws to enable the turned-round end of the wire to be inserted so the mandrel was held in a split bush, 1/2 in. long, made by drilling a 3/32 in. hole through a piece of 1/8 in. dia. brass rod and slitting lengthwise with a fine saw. If the hole is made a close fit on the silver steel, there should be no necessity to slit the bush. The lathe is run at bottom backgear speed in reverse and the wire gripped as firmly as possible in some thick rags so that a good tension is constantly maintained. The wire is run on, close coiled, for about 20 turns — say 3/4 in. — and then it is cut off from the stock leaving a tail about 1 in. long.

Hold one free end of the wire in a vice, grip the other with pliers and stretch the spring until the gaps between the coils, after the tension is released, are rather more than the wire diameter — in other words, pull the spring out until it is twice its solid length. This amount of stretch will prove to be excessive so the spring is slipped over the mandrel, one end of which is held in the vice, and it is compressed solid. This will stress the wire beyond its yield.point and so reduce the length of the spring to the maximum that can be used without subsequent collapse. Because the spring, under working conditions, is never compressed to the solid state, the yield point will never again be reached and the spring should function indefinitely. The ends are cut off with snips to leave the correct number of coils which are tidied up by touching on the grinder. After all that working the wire will be full of locked-up stresses and instead of consulting a psychiatrist we can, more usefully, let some of them down by heating the spring in a blueing pan until it is purple to dark blue.

TOOL-BITS. Nominally, 1/4 in. dia. HSS. Length required is 1 3/8 in., minimum 1% in. and maximum, 1% in. "Eclipse" toolbits are 1/4 in. by 2 1/2 in. which is not a very convenient length. Much more economical are 1/4 in. "drill blanks" which are almost 4 in. long and cost little more than half the price of the "Eclipse" bits. One blank will provide two screw-cutting bits at 1 3/8 in. long plus a short end for use in boring bars.

Round bits for screwcutting take up much less room than the more usual square form of tool and can therefore be worked into more compact holders. They can be turned to suit any helix angle and they are more readily ground to accurate forms. Finally, they are much cheaper. On Fig. 5 are given details of a tool suitable for cutting 8 t.p.i. Whit. form threads. The vertical flat on the L/H side permits threads to be run into small undercuts against shoulders and it forms a reference surface for setting the tool to the desired angle, either in the toolholder or in the holders used in conjunction with the tool grinder.

Materials and parts for making the toolholder are obtainable from N. S. & A Hemingway of Rochdale.