DRILL SHARPENING

From what has gone before it is evident that sharpening a drill means more than just putting an edge on it. See Fig. 32. The two lips or cutting edges 'a' must be of the same length, and the point angles 'b' must both be correct and equally disposed about the drill axis. The clearance 'c' must be sufficient. The leading edges of the lips must be level as shown at 'd' – this will follow automatically if 'a' and 'b' are correct. And the chisel edge angle must be correct, at 'e'. (The figures shown are those for a 118° point with 10-12° clearance angle, normal helix.) To grind a drill by hand calls for considerable skill and experience, and this can only come from practice. You must expect to "get things wrong" for quite a while – or at least, "get things not quite right"! – but it will help if you practise without a grinding wheel to start with. Seek out the largest unused drill you have – mine is $^{31}/_{64}$in., a hole size I seem never to have used. Find a vertical smooth metal surface and cover this with marking blue. Offer the drill point and practise the motion needed evenly to coat the drill point

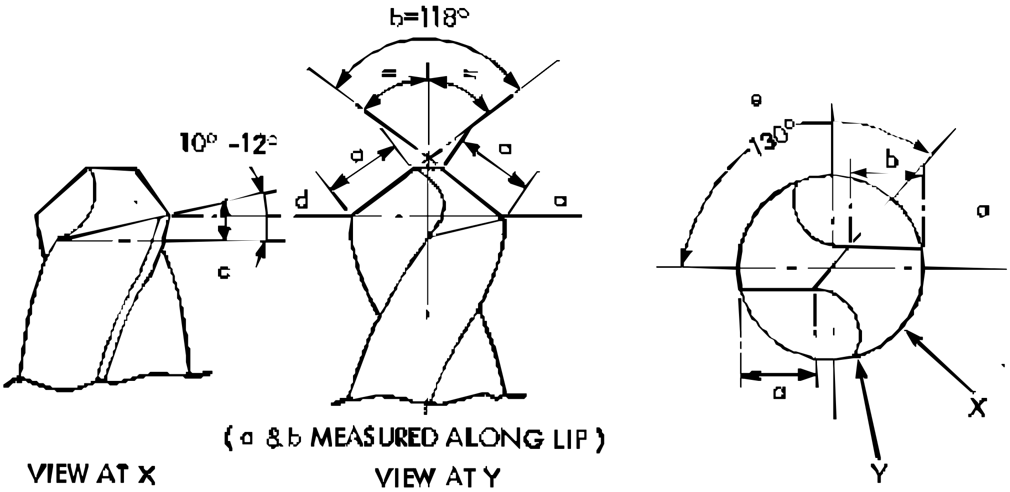


Fig. 32 *The critical elements needing attention when sharpening a twist-drill.*

with blue. You will find that you have to (a) hold the drill at the correct angle; (b) gently raise and lower the left hand (the one holding the point end); (c) move the right hand slightly up and down and side to side at the same time; and (d) slightly rotate the drill with the right hand – all these motions occurring simultaneously!

Practise this until you can get a reasonable cover of blue on the point. Then take an old drill and try it on the grindstone. Note that you must use the flat side of the wheel, not the periphery. Yes, I know that "everyone says" that you should never do this, the reason being that wheels are not very strong sideways. But the force used in drill-grinding is and should be *very* slight and I can assure you that no harm will come. The ideal wheel is, of course, a cup wheel, but few bench grinders will accept one. After a while you will find that you can get a reasonable approach to the correct angle and clearance. You must now practise further to get both sides even. This will take you quite a while, but persevere! It is extremely doubtful that you will ever get a drill absolutely correct with off-hand grinding like this, but you should not have a *great* deal of trouble in achieving a tolerable point – so long as you practise. Remember, the aim is to take off the minimum amount necessary to renew the cutting edges of lip and chisel point. I always finish my drills with a medium fine India oilstone – you will remember that the clearance faces to the lips form the rake faces to the chisel edge, and should, therefore, be smooth.

Far better than off-hand grinding is to use a drill grinding jig. Fig. 33 shows the well-known "Potts", marketed since Mr Potts' death by Woking Precision Models Ltd. (There are others of similar design.) It is a reduced version of the man-sized jigs formerly used in industry, before

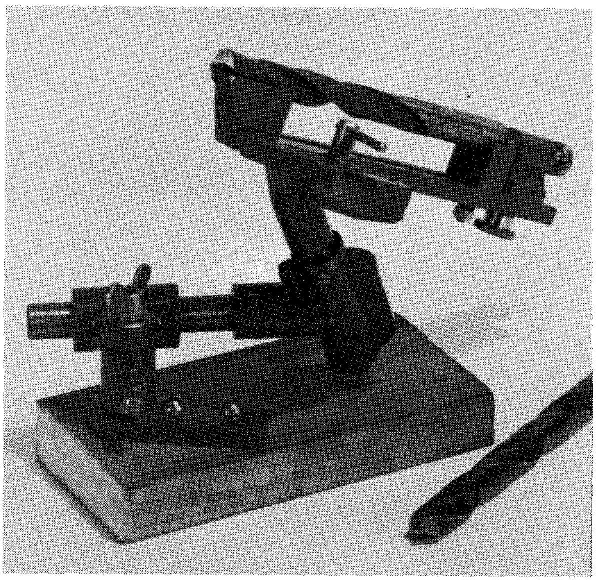


Fig. 33 *The Potts drill sharpening fixture for use on the bench grinder.*

special-purpose drill-grinding machines (costing thousands of pounds) became universal, but has none of the complications of vernier angle settings, micrometer feed devices etc. found on such. Properly used it will give a point very near to perfection *provided that it is set up and used correctly*. Follow the assembly instructions exactly, so that it is presented to the grinding wheel in precisely the fashion intended by the designer. The main problem in use is in the accurate setting of the drill point to the stop in the jig. This must be done very carefully. It would be a waste of my time to go through the instructions as, although I have a Potts which I have used for nearly 30 years there are other similar devices available and each has its own setting method. I think I should add that when properly set up these jigs often "look wrong". Don't be alarmed – just check through the instructions and make sure that you have not made a mistake, and then press on!

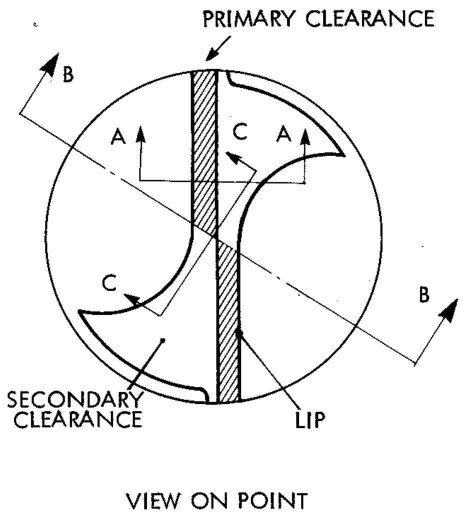
"Other Devices"

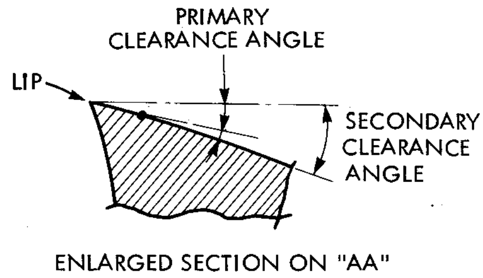
There are, of course, many devices other than these. Some are basically identical to the Potts and not to be disdained. After all, Mr Potts based his design on the more elaborate industrial type. Others often appear to be crude, but do serve their purpose – the restoring of the edge of drills used for "Do-it-yourself" projects etc. The handyman is seldom concerned with accuracy to the last hundredth of a millimetre or with drill performance, and for this class of work it is far more important that the edge should be keen than that it should conform exactly with the design geometry. Such cheap gadgets are much better than unskilled off-hand sharpening! Indeed, I confess that I have one, made entirely of plastic, which puts an edge on by rubbing the point on a sheet of silicon carbide paper, maintaining the angles by the peculiar motion of its "wheels". It works, and with care can work quite well enough for me to prefer it to off-hand grinding when I am in too much of a hurry to set up my Potts or the Quorn. But it is used *only* on the drills I keep for use in the hand or electric portable drill-drivers. In which connection I would urge readers NOT to use their "workshop" drills, and especially not their tapping drills, for D.I.Y. odd jobs. Small drills are easily bent, and larger ones can suffer badly from both chisel edge and land wear when used with portable drilling engines. However, even "second best" drills should be kept sharp, and a cheap drill sharpener, used with care, is well worthwhile.

The "Four-facet" point

This type of point grinding has become increasingly popular following the introduction of numerically controlled machine tools, (though it has been in use since about 1905), as it is more or less self-starting and needs no preliminary centre-hole. The difficulty for the amateur user is that it is almost impossible to produce the shape by off-hand grinding, and an error in the profile is much more serious than in the case of the relieved cone point which we have considered so far.

Fig. 34 shows the arrangement. There is a double clearance angle; the primary angle, 'A', gives the major clearance and corresponds to that produced in a relieved cone drill. The secondary angle, 'B', is the cutting edge clearance. This secondary clearance is carried right to the centre of the drill, so that there is a *point* on the chisel edge instead of a flat; I have shown an end view of this





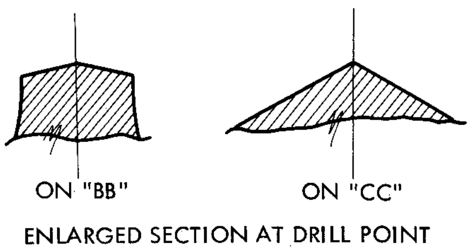


Fig. 34 *The "Four-facet" drill point.*

type of grind in Fig. 34, and you can see the difference. If used with stub drills this grind completely obviates the need even for centre-punching (provided that you can position both drill and work sufficiently accurately) and on jobber's length drills a marked reduction in the tendency for the drill to wander from (e.g.) the centre-pop will be observed. There is, in addition, evidence that in deep hole drilling the drill runs much straighter.

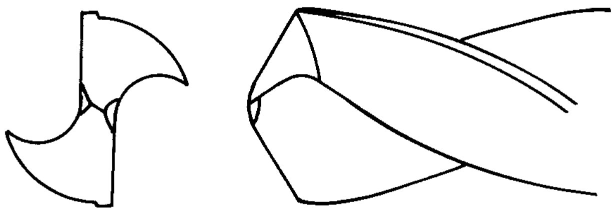
So far there appears to be no simple drill-grinding jig on the market which can produce this grind, and the machines used in industry cost rather a lot of money! However, the Quorn tool and cutter grinder *can* grind the four-facet point (but can't grind the relieved cone without modification) and full instructions are given in Prof. Chaddock's book "The Quorn Tool & Cutter Grinder", from Argus Books Ltd. All the considerations about equality of lip length, accuracy of angle-setting for both point and clearance, and so on, apply equally to the four-facet and relieved cone points. I would emphasise this again: neither the use of a drill-grinding machine, a "Potts" jig, nor a "Quorn" will guarantee a good point to a drill unless the instructions are carefully followed and the drill properly set up in the holder.

Point thinning

On larger drills (say above 12-15mm dia.) other considerations apply, notably the need for strength to resist the high torsional and thrust forces. It is doubtful whether the four-facet grind offers any advantage in these larger sizes. However, to provide the necessary strength the web of the drill is quite large – perhaps 3mm (⅛in.) on a 15mm (⅝in.) drill – and the consequently wide chisel edge can cause problems both in starting and when drilling. To overcome this the point is usually "thinned" as shown

**The 4-facet point is *not* recommended for use on brass as it may cause "grabbing". See pp 17/18.

Fig. 35 *Reducing the chisel edge by point-thinning the web.*



in Fig. 35. Two narrow grooves are ground along the line of the chisel edge, and this reduces it almost to a point. At the same time the acutely negative rake angle is reduced, thus providing better cutting conditions. On smaller drills – say below 10mm (3/8in.) – little advantage is gained, and the grinding operation involved becomes tricky. However, for drills between about 8mm and 12mm the increase in web thickness as the drill becomes shorter due to regrinding can become a nuisance, and in these cases point thinning may have to be resorted to when about half the usable length has been ground away. Point thinning is always used on drills above 12mm (1/2in.) when shortened in this way.

I have found considerable benefit when using large (above 12mm, or 1/2in.) drills in the lathe, the reduction in thrust making the difference between a "struggle" and almost normal drilling. But with anything much smaller there is little benefit and below 10mm I never thin the point, even on well-shortened drills. Thinning is a very delicate operation, and if not done exactly right the last state is worse than the first. It is important that the "nicks" cut in the chisel edge should be identical in length and preferable that they be the same depth also, otherwise the drill will cut large and probably run off line as well. There is also a risk of accidentally touching the lip cutting edge. A thin saucer-type grinding wheel is needed, of course – the edge of a normal grinding wheel, even if a sharp corner, has too great an angle. To do the job properly needs a grinding jig, and Fig. 36 shows a set-up designed and built by

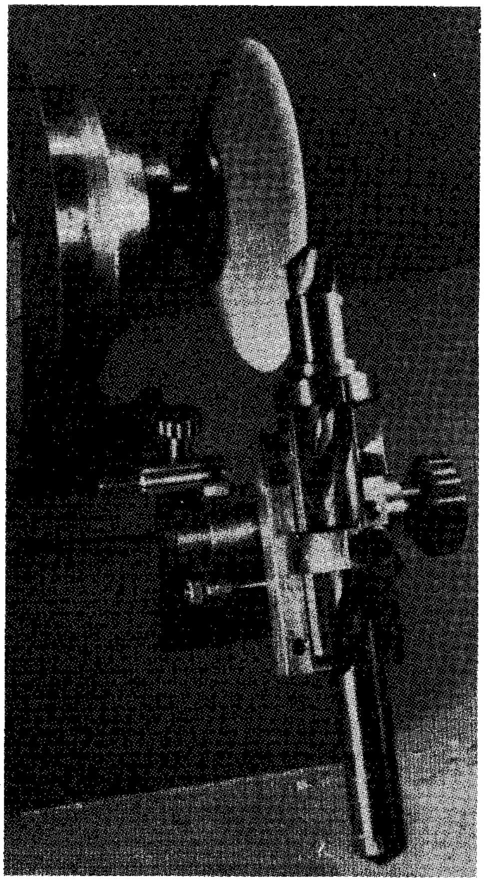


Fig. 36 *The Bradley point thinning fixture. (Courtesy Ian Bradley Esq.).*

Mr Ian Bradley. The wheel is about 100mm (4in.) dia. and as you can see has been dressed to a very thin edge. The drill can be set accurately in the holder and clamped up, after which the depth of the thinning groove can be adjusted and, finally, fixed when the holder is rocked towards the wheel. No doubt those who have a Quorn could devise a similar arrangement. I would NOT, however, advise any but the most skilful reader to attempt to thin the point of any drill less than about 12mm (½in.) dia. working freehand on the bench grinder. It is worth noting, when considering point thinning of a much-used drill, that the diameter across the lands is tapered, being largest (to the nominal diameter) at the point. This taper is typically 0·02 to 0·08mm in 100mm (0·001 to 0·004in. in 4in.) length This is to prevent binding in the hole. Clearly, a worn and shortened drill will be undersize on the diameter.

Land Wear

This last fact leads to another. The lands on the flutes (see Fig. 9) guide the drill, and also establish the diameter of the hole which will be cut – assuming that you have ground the point correctly! Even in ideal circumstances these lands will wear, but as soon as the point geometry is less than perfect there is considerable extra load applied to one or other of the lands. This increases the wear rate. Sooner or later the lands at the point end will wear down to a smaller diameter than that further up the drill. Then, when drilling a hole deeper than usual these unworn parts will rub on the sides of the hole and, in the worst case, actually jam the drill in the hole. *There is no cure,* other than shortening the drill back to beyond the worn land faces. So, if you find that a