REMOVING METAL

By GEOMETER

ALL methods of metal removal resemble one another in so far as the action is one of tearing material from the surface. In turning (A), it is done with a single tool, the swarf often coming away in a long coiled strip. In milling (B), metal is removed with a cutter which has several teeth, the swarf being in chips or flakes. In grinding (C), metal is removed with a multitude of fine teeth, each formed by a single particle of grit in the wheel. The swarf is in minute strips or fragments.

Grit for grinding wheels can range in size from coarse sand nearly to powder. At the extremes, these provide rough ground finishes and almost polished surfaces.

For finer finishes still, lapping is necessary, and sometimes the abrasive particles are very small. They are too fine to be put through a sieve or screen, and are graded by " elutriation." Basically, this means that abrasive of different dimensions is put in a water tank. The larger particles sink first. The smaller remain in suspension. They are drawn off with the water and deposited in another tank. On this principle is obtained the grade of emery known as 240 minutes, this being the time taken by particles to fall through one metre of clean water.

Thus, at one extreme, metal removal may be done with the single cutting edge of a lathe, tool, and at the other extreme with the innumerable cutting edges of a powder abrasive.

Except with very fine lapping, cutting tools or edges are held firmly -the lathe tool in its holder, the teeth on the milling cutter. the grit in the bond of the grinding wheel. In coarse lapping, particles of abrasive become embedded in the lap *(D).* When they are very fine, they stick or wedge to it.

The tearmg action of removing metal is facilitated by a sharp cutting edge. For turning most steels, rake and clearance angles should give a stubby tool (Al) to avoid breakage. For softer materials,_ these angles can provide a more pomted tool. For wood, it can be very acute (A2).

These conditions, with what they imply, are parallelled in grinding. Grinding wheel manufacturers will recommend a type and size of grit and its bond for different materials. In turning, we control tool angles, advance and peripheral speed according to the dimensions and type of material. But after a time the tool must be reground. In grinding, the cutting edges of grit become dull with use, and the blunted particles break out of the bond, exposing sharp, unused grit. This is why a grinding wheel wears. For important work, of course, the wheel is dressed again.

In turning, there may be trouble with swarf building on the edge of the tool (A3). It can be avoided through a sharp edge, honed faces and use of suds or oil. In filing, swarf may likewise adhere between teeth. To obviate a build-up, you can rub chalk on a file. A chisel-edged piece of brass pushed in line with the teeth will clear them of swarf.

In grinding, a wrong type of wheel may be clogged between grit (C), or by grinding dry instead of with suds Aluminium is particularly liable to stick like this. Then the wheel must be dressed to clean it, with a dresser, a diamond tool, or a piece of broken emery wheel.

In lapping a bore with a solid lap, there must he clearance (El) to allow for the abrasive. When this is coarse, greater clearance is obviously needed than when it is tine. In practice the lap is turned with a slight taper and smeared evenly with abrasive. Then the bore is tried on to obtain the position at which to turn the lap parallel.

When a bore is taper (E2), the parallel part of the lap should suit the larger diameter. The taper end should be used first in the smaller end of the bore, which will lap out parallel.

Annular grooves (Fl) may be turned for holding abrasive in a well-fitting finishing lap: and a pattern of filed V-grooves (F2) can be made in the face of a flat lap.