MILLING CUTTERS and OPERATIONS

While the main group of circular features on components such as bores, diameters, spigots, annular grooves, etc., derives naturally from turning, straight line features like slots, keyways, ports, squares and angular flats are no less inevitably the outcome of milling. Many components comprise no other features than these and so can be produced entirely by turning and milling-in model and other small sizes-wholly on the lathe, employing simple cutters for milling, and with set-ups made on topslide, cross-slide, or vertical slide.

By GEOMETER

In small sizes cutters can be made from silver steel rod at little more than the cost of lathe tools, with the additional advantage that they are exactly applicable to the features. Depending on type, they can be run in the chuck, directly or on a mandrel, with or without support from the tailstock, or in a holder fitted in the taper in the spindle.

A long keyway in a shaft or a slot as at ***Al,*** can be produced with an endmill. To make this the silver steel rod is turned to the width of the keyway or slot for the cutting edges to be filed, and the tool hardened and tempered. Alternatively, a long keyway can be produced with a slotting cutter as used for milling a seat for a Woodriff key, as at A2. This cutter requires silver steel rod as large as its outside diameter-but in small sizes is not too expensive. It is turned as a flat-sided or side-relieved disc at the end of a shank; then the teeth are filed and hardened and tempered.

With a number of such cutters on a shank-the outer end of which requires support from the tailstock, gang-milling operations in small sizes can be performed. An example of this is milling steam and exhaust ports for a slide-valve cylinder, as at ***B.*** The width and spacing of the ports are naturally those of the cutters, with the milling a plain " sinking-in " operation as for milling a Woodruff keyway; and the ports finish with square ends as against the rounded ends left by endmilling.

There are limitations, of course, in such a gang-milling operation. They are imposed by the length of the ports and the depth to which the cutters can be sunk; but where it is applicable there is the advantage that the ports are cut precisely spaced and accurately to length without raising or lowering the portface or feeding it sideways, as when endmilling.

Enough stock can be left on the cutter for it to be run from the chuck; or if that would be too wasteful, a shank of moderate length can be turned to mount in a holder fitted in the taper in the lathe spindle. A holder of this type, as at C, is convenient for a small endmill, affording a better hold than a chuck and with a smaller swinging diameter to clear work-holding clamps and nuts.

Using mild steel rod held in the chuck and supported by the tailstock centre, the holder can be turned with a taper to enter the spindle where it can be faced, centred, drilled and reamed-or bored with a small tool for endmills and the standardised shanks of slot mills to push in comfortably without shake. For a distance back of 1/2 in. to 5/8 in. the end can be turned about 1/4 in. larger than the bore diameter, then slit longitudinally as shown.

No hogging

For a larger slotting cutter, which for economy can be turned from flat plate, clamping can be by a nut and collar on the end of a mandrel, as at ***D.*** To prevent slip, there can be a pin in the shoulder of the mandrel; while a corresponding hole in the collar will allow the pin to pass through cutters of different thickness, and for each provide a full width drive.

In preparing blanks for endmills and slotting cutters, clearance of 2 or 3 deg. can be given as at ***E, to*** obviate " hugging" in deep slots. When finishing the teeth, which can be done by careful work with hacksaw and files as they need not be accurately spaced, they can be left full width at the ends and with rake and clearance angles, as at ***F,*** of 5 to 7 deg.