BY *Geometer*

How 'to plane small gears

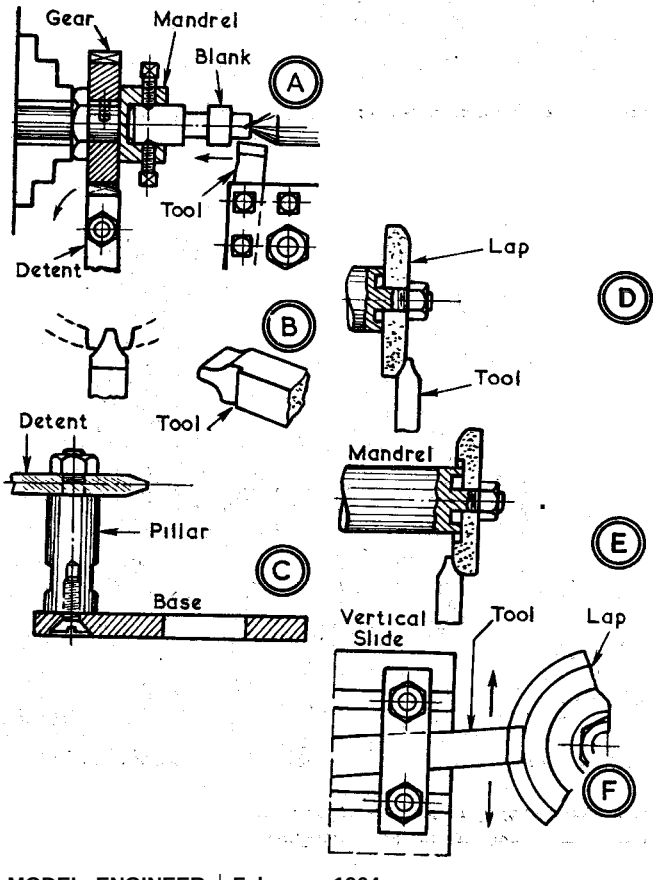
ALTHOUGH small gears can be bought in many sizes, they must sometimes be made at home because a standard one is not right in size, in number of teeth or in material. You may need a steel gear instead of a standard one of brass; or a gear which is to hand may have too few or too many teeth to give the required ratio. And there is the satisfaction which comes of making all the parts of a model or mechanism yourself.

Providing that the gears are of fine pitch, planing with a form tool in the lathe is a practical way of making them, a gear blank being turned to size and mounted with a change gear on a mandrel when the lathe lacks a division plate or other means for indexing. The tool is clamped to the top-slide, like a turning tool, but with its profile facing the head-stock; and the saddle is used to make cuts, which are taken down to the depth of tooth by the cross-slide. This method cannot be used for large teeth, which must be made on a different set-up with a rotary< multiple:toothed 'cutter or a flycutter.

For planing, you need a tool of the proper size and shape in silver steel, .which is first hardened outright and then tempered to the usual dark' straw colour at the working' fdge. The shape of the tool varies with the number of teeth m the gear. To make a tool, you need a pattern gear which has either the same number of teeth or a number which is within a given range. You cannot use a rack as a gauge or pattern to make a form tool to plane a pinion with 12 teeth, or vice ***versa,*** for the two tooth shapes are entirely different.

Standard involute gear cutters are made in sizes each of which covers a range of teeth. We can choose in these ranges a gear which we can use as a pattern or template to make the tool for planing another gear. Particulars of standard cutters are:

No 1 cuts gears from 135 teeth to a rack, inclusive.
No **2** cuts gears from 55 teeth to 134 teeth, inclusive.
No 3 cuts gears from 35 teeth to 54 teeth, inclusive.
No 4 cuts gears from 26 teeth to 34 teeth, inclusive.
No 5 cuts gears from **21** teeth to **25** teeth, inclusive.
No 6 cuts gears from 17 teeth to ***24*** teeth, inclusive.
No 7 cuts gears from 14 teeth to 16 teeth, inclusive
No 8 cuts gears with **12** teeth and 13 teeth.



Now, if we have a pattern gear with 40 teeth, and we need a gear with 50, we can use our gear fox the 'form tool, turning the gear blank to a suitable size. It is the same if we need a gear with 35 teeth, as this, like the other, is in the same range (No 3 cutter). But if we have a gear with 15 teeth (No 7 cutter), we cannot use it as a pattern for a form tool for a gear with 30 teeth (No 4 cutter), as the profile is not suitable.

Diagram A shows a set-up for planing a gear. A steel mandrel which is held in the chuck has a change gear keyed by a peg and clamped by a nut. At the front end is a bore in which the stock of the centred blank is gripped by pointed screws. This blank is turned with normal tools; and when the gear has been planed, the stock can be chucked and the gear drilled and bored to fit its shaft. The waste material comes in useful for other jobs.

On occasion, a change gear is mounted direct on the stock of the blank, but a mandrel allows for the use of different change gears. Thus, one with 60 teeth can be used with 60, 30, **20,** 15 and 12 teeth. One with 80 teeth can be used for gears with 40,20 and r 6.teeth.

Diagrams B and C show the form tool and an index. The index is made in mild steel, with a flat base, a round pillar and a swivelling detent, clamped by a nut at the top. It can be adjusted through the slot in the base to change gears of different size.

The trickiest part of the whole job is, of course, the making of the form tool. To get the profile of a tooth space, you need good eyesight, a magnifying glass or a bench microscope. File a silver steel tool to fit one flank ,of a tooth. Harden and temper the tool and use it to machine a curve on a light-alloy lap on a mandrel. Prepare the form tool as- accurately as possible by filing, and mount it on the vertical slide. Use the lap one way and the other, as at D and ***E,*** raising and lowering the tool, as at ***F,*** while feeding the lap with grinding compound above a tray on the lathe bed. Lap each side of the form tool until it fits the pattern gear exactly. Then harden and temper it. In this way you get a centralised form,.the same each side, so that teeth on your gear are not malformed or falling over: