RATIOS
in
GEARING

By GEOMETER

ACQUAINTANCE with the main principles of gearing enables many of the problems met with in workshop practice, and in design and layout of simple mechanisms, to be solved without difficulty. In most problems ratios are likely to be involved, for it is usually the function of gearing to achieve definite rates of turning without slip.

In simple gear trains, as at *A*, ratio is settled by the numbers of teeth in the driving and driven gears, without reference to the number of teeth in the intermediate or idler gear. Thus, with 25 teeth in the driving gear, and 50 in the driven, the ratio is 2 to 1, the smaller dividing into the larger twice; in other words, making two turns for one turn of the larger.

The principle applies if there is more than one intermediate or idler gear, as gears in rotating " take in " a tooth and " give out " one. Hence with 25 teeth in the driving gear and 40 in the driven. the ratio is obtained as before: $\frac{40}{25} = 1\frac{15}{25} = 1\frac{3}{5}$ to 1.

Besides connecting driving and driven shafts, intermediate gears can, however, be employed to settle the direction of rotation of the driven gear, and also to distribute wear if this is likely to fall mostly on certain teeth. Simple gear trains with odd total numbers of gears give'rotation of the driven gear in the same direction as the driving gear; while even total numbers of gears give reverse rotation.

In a compound train of gears, as at *B*, rotation is the same for the first driving and the final driven gear, but the two ratios must be multiplied together to obtain the final one. With 25 teeth in the first driving gear, 60 in the first driven, 30 in the second driving gear and 50 in the second driven, the ratio is:

$$\frac{60}{25} \times \frac{50}{30} = \frac{3000}{750} = 4 \text{ to } 1$$

The result would be the same if driving gear with 30 teeth engaged driven gear with 60 teeth; and if driving gear with 25 teeth engaged driven gear with 50 teeth.

To distribute wear through intermediate gears, the principle is of the " hunting tooth " and is useful where cams may be operated. and where all the load would fall over a few teeth. Thus, as at C, an overhead camshaft drive can be arranged for 2 to 1 ratio using appropriate numbers of teeth in the driving and driven gears, and odd teeth in the intermediate gears, the ratio being:

$$\frac{25}{24} \times \frac{48}{25} = \frac{1200}{600} = 2 \text{ to } 1$$

A car gearbox incorporates compound and three-shaft and four-shaft gear trains. In the " crash " type, as at *D*. the engine drives the ordinary shaft, the mainshaft is coupled to the axle; and the layshaft is in constant mesh with the primary shaft, forming the first ratio of a compound train.

For first, gear W is moved to the right; for second, it is moved to the left. For third. gear V is moved to the right; for top-it is moved to the left, coupling direct primary and mainshafts. For reverse, another gear (not shown) is inserted, making a four-shaft train.

In single-start worm gearing, where lead and pitch are the same, as at *E,* ratio is given by the number of teeth in the worm wheel; but shaft centres can be adjusted by the radius X of the worm. Withmulti ple-start worms, the number of starts divided into the worm wheel teeth give the ratio. In a double-start worm, as at *F,* lead is twice pitch, with starts opposite at Y and Z.