The quality of squareness

SQUARENESS is one of the universal qualities of engineering which is of vital importance to the proper working of machines. In theory, of course, there may not seem to be much to it; lines on drawings can represent faces at right angles, and by implication even the roughest sketch is correct.

But it is another matter for the practical worker, who must be constantly alert to ensure squareness in machining parts, and to maintain it in their assembly; for it does not occur automatically, even when one might reasonably think it should.

By GEOMETER

In the simplest case, for example, a piece of dirt or swarf, or an overlooked burr, can put faces out of square.

When measuring parts by micrometer, care must be taken to apply it squarely, or the test will not be accurate; there should be a light hold on the instrument, and a gentle touch on the thimble or ratchet. Squareness is likewise essential when using a fixed gauge, or limit gauge.

When two diameters are concerned, lack of squareness results in characteristic jamming, which is most marked when the diameters are a close sliding fit, or an interference fit.

The effect often encountered when a bore is tested by plug gauge. Over the small range at which the gauge can be lightly forced in, or pushed in if held squarely, jamming can occur, as at *A.* A judicious tap is needed to square the gauge, or it jumps across the diameter and jams the other way. This can happen indefinitely. To square and free the gauge, however, a push with a bar using the cross slide is all that is necessary.

The effect is avoided by providing the gauge with a pilot (1) which will easily enter the bore of the work. Alternatively, on a parallel gauge, a V-groove (2) will prevent jamming. It can be turned as the gauge is machined, or ground in afterwards.

Jamming similar to that of a malaligned plug gauge can occur when ball races are fitted or removed, if they are not kept square in their seatings. Preferably, in fitting a ball race, it should be pressed in with a piece of flat metal or a distance piece to its outer ring, though a punch and hammer can be used-working round evenly, a policy which should also be followed in removing a ball race by punch and hammer; it should not be "walked out " with heavy askew movements.

Squareness in turning is ensured when work is faced, turned and bored at a single chucking; and many small concentric parts can be made like that, then carefully parted off so that they are true all over. For others, which are larger or more complicated, a mandrel is the habitual solution to the problem of squareness on the second set-up-as at *B*. Here, if required, the work can be faced each side.

In a similar manner, a wheel can sometimes be lightly skimmed on faces and diameters after it has been pressed on a shaft or axle. But when that is not possible-owing, perhaps, to chatter, extra care must be taken in fitting, to ensure that it spins truly.

A shoulder on the axle aids alignment, as does a tiny chamfer on the entering diameter-though it reduces the interference fit. To avoid this, an axle can be overlength, as at C, centred deeply, and finally faced on a half-centre.

The vice is a ready means of assembling parts squarely, used with flat material, washers and distance pieces. Two flat pieces protect parts against damage, as at *D* (YZ), where a flush-fitting bush is represented as being pressed into a rod. Here the pieces are joined by adhesive tape to suspend from a finger. On other occasions, they can be stuck to the job. Slight malalignment may raise a burr in the rod, or material may be rubbed from the outside of a bush-two points to check before the final squeeze.

Squareness of a through-bush in a rod can be verified by surface gauge on a surface plate, as at *E;* while alignment of replacement bushes can be ensured by reaming through an old one into the first new one, as at *F.* ❑