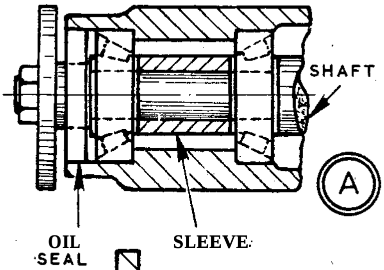
Pre-loading bearings

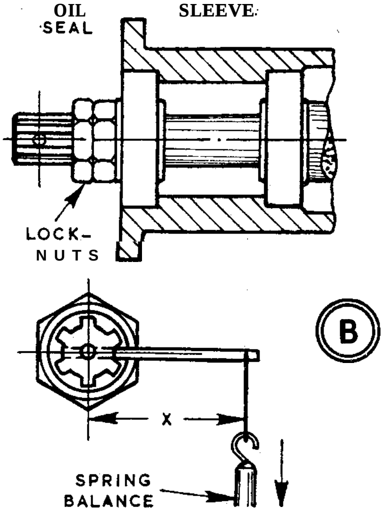
WORKSHOP HINTS AND TIPS

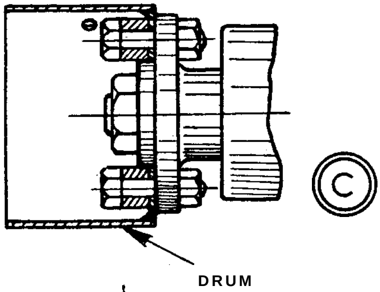
By GEOMETER

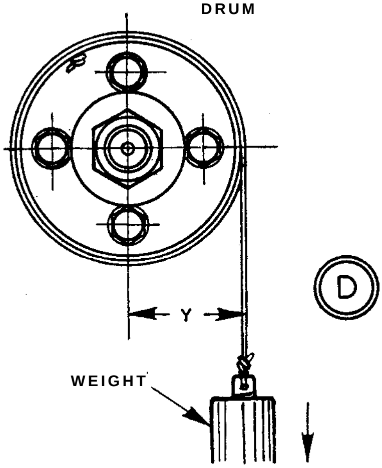
THE principle of torque in tightening is of considerable importance in modern machine and component assemblies employing special ball or taper roller bearings in opposition. The spindles or mandrels of lathes, milling machines and other tools may incorporate such bearings, which are now also standard for pinion shafts and differential carriers in rear axles of cars.

The torque required to turn the lathe spindle or the pinion shaft of the axle is often called pre-load, and given in lb. in. It represents largely the load above ordinary friction applied to the bearings in assembly. That is, if the bearings were assembled just without play, they would be subject to friction and require a little torque for turning. But by pre-loading, a noticeable and specified increase in torque is made.









Pre-load, however, can be established in another way. When bearings are assembled just without play, a reference measurement can be made over them endwise. Then it can be arranged to bring them together some small pre-determined amount (say, 0.002 in.), and this is the pre-load, though naturally it has the effect of increasing the torque required to turn the shaft, as the principle is the same as before.

Pre-load-as determined by bearing and component manufacturers-needs to be reasonably correct. Otherwise if too heavy, there can be resistance, overheating, and possibly early wear of the bearings; while if not pre-loaded enough, a lathe spindle, for example, would run loose and be subject to chatter, and a car rear axle would whine on drive or over-run.

In addition to this torque (usually a small figure in lb. in.) to turn the shaft, the nut or nuts on the shaft may be given a spanner tightening torque as a very considerable figure in lb. ft. Clearly, this is important, too, for tightening of the nuts brings the bearings together, and can thus affect the other torque or pre-load.

It must not be overlooked that pre-load specified refers only to the bearings, so it cannot be tested while the shaft, or the gear at its end, is engaged m any way. If an oil seal is fitted it must not be in place for checking pre-load unless the manufacturer has specially allowed for it.

Again, two figures may be given for pre-load, a high one for new bearings and a low one for bearings that have been run-in. These must not be confused with two figures together showing limits of pre-load, such as 3 to 4 lb. in. Here, a torque of 3 lb. in. should not turn the shaft, while one of 4 lb. in. should be capable of rotating it.

At A and B are examples of pinion shaft assemblies with taper roller bearings. At A drive is taken from an outside flange, and there is an oil seal which must have been allowed for in the pre-load or be absent when testing.

The bearing outer members are separated by shoulders in the casing, and the inner members are spaced by a sleeve, at the end of which shims normally allow for adjustment. If a test shows insufficient pre-load, the shaft is removed to extract one or more of them.

At B bearing outer members are separated as before, but there is no spacing sleeve, and locknuts, usually with washers, admit of applying pre-load. The splined end of the shaft is enclosed, taking the drive through a sleeve from the propeller shaft.

Testing of the pre-load can be done with a rod length X through the shaft, pulling on it at right-angles with a spring balance. Length X in inches X balance reading in pounds = load in lb. in. For a shaft with a flange, a sheet metal drum can be made to bolt on as at C, and a cord wrapped round and a weight applied as at ***D.*** Then radius Y in inches X weight in pounds = pre-load in lb. in.