Grinding Hobs After Hardening.

Even after this lengthy process it is sometimes found that a hob has gone slightly out of pitch in the hardening. Attempts have been made to correct this by grinding the sides of the hob teeth after hardening. For this purpose a small emery wheel was used in the backing-off machine, but, owing to the small diameter of the emery wheel which had to be employed to pass between the threads and the great speed required, this has not proved very successful.

The author has brought out a hobbing cutter with inserted blades or racks which are fitted into grooves cut in the body of the hob. These grooves are not cut radially, for in a cross section of the hob the centre lines of the grooves are tangential to a small circle concentric with the periphery of the body. The thread is roughly cut and then the blades are taken out and tempered, and the parts that fit in the body are ground. They are then replaced in the body and the thread is ground up all over, so that any error due to tempering is corrected. The blades are again taken out of the body and turned end for end in the grooves, being replaced so as to keep the continuity of the thread. Owing to the grooves being tangential, this will tilt the blades and so give the necessary clearance or backing off to the teeth. The blades are rigidly held in the grooves of the body by long keys. Several sets of blades of different pitches either diametral or circular can be used in the same body, and if a tooth gets broken, it only means that one blade is spoilt and this can easily be replaced. It is thought that this method of construction will lend itself particlarly to hobs of large pitch, as at present the large solid hobs are very expensive. At the time of writing only two of these hobs have been made, and it is still too early to say how far they have an advantage over solid hobs. The results obtained are, however, sufficiently good to encourage further trials.

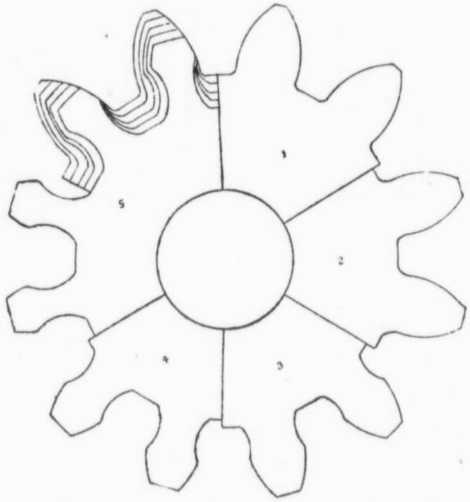

Fig. 1.—Portions of five 12-tooth Pinions on blanks sized for 11 teeth up to 13 teeth.

Undercutting of Pinions.

One point sometimes urged against the hobbing principle is that, as all the wheels are generated by rolling into a rack, the flanks of pinions must necessarily be undercut. The teeth of pinions could be made stronger by increasing the angle of the sides of the rack teeth, but this has the disadvantage of increasing the angle of obliquity and so throwing a greater outward thrust on the bearings. Nevertheless the evil effects of this increased angle of obliquity are thought by many to be exaggerated, and Wilfred Lewis recommends the use of involute teeth having an angle of obliquity of 22½ degrees.

The author is, however, in favor of retaining the present form of hob having sides inclined to each other at an angle of 30 degrees. In the case of wheels of less than 30 teeth he recommends that the blank should be turned to a rather larger diameter than the correct diameter for the number of teeth required. The cutter is set to the full depth of the tooth just as if the blank were the correct size. The base circle from which the involutes are unwound, is not altered by altering the size of the blank, but if the blank is over size we shall get teeth very strong in the roots with short flanks and long addenda. The centres of the wheel and pinions are, however, slightly fallen apart and the angle of obliquity is increased. Thus with the same hob, almost any desired strength can be given to the teeth of a pinion, and all the pinions will gear perfectly with the wheel cut on a correctly sized blank.

It must be understood that there are limits to the amount of error which can be given to the diameter of the blank, for if the error is too great the teeth will be cut off altogether. As an illustration, take a 24-tooth wheel gearing into a 12-tooth pinion of 2 diametral pitch. The correct centres for these are 9 inches apart and the angle of obliquity is 15 degrees. Now cut twelve teeth on a blank intended for thirteen teeth. The centres will now be 9¼ inches apart and the angle of obliquity is 21 degrees. This is rather an extreme case, but a very strong form of tooth can be obtained with a blank sized for 12½ teeth. The longer involute of the pinion teeth causes these wheels to run very smoothly together. Fig. 1 illustrates a series of 12 tooth pinions cut on blanks sized for 11 teeth up to 13 teeth. The third in the series is cut from a blank of the correct diameter.

Disadvantages of Disc Milling Cutters.

The introduction of automatic gear-cutting machines cheapened cut wheels to such an extent that they soon came into favor for all high-class work. As has been explained, unless the number of teeth to be cut in the blank correspond to the lowest number stamped on the cutter, the teeth will not be correctly shaped. Moreover, as the cutter gets blunt, the centres of the cutter and work mandrel are forced apart, and the bottoms of the teeth describe a slight scroll. Also as one tooth is finished at a time, the strains of the metal being released locally and the heat generated cause the wheel to be distorted from a true circle.

Disadvantages Overcome by Hobbing Machines.

The extraordinary demands of modern high speed machinery rendered it necessary to find something still better. In all gear generating machines the teeth, no matter what number there are in the wheel, are developed to the true involute form so long as the tool keeps sharp, and in the gear-hobbing machine which generates the teeth simultaneously nearly all the disadvantages of the disc milling cutter are overcome. Moreover, while the milling cutter has about twelve cutting teeth in the case of a hob the cutting is done by about thirty teeth. In practice it is found that with a good stiff hobbing machine, from two to three times as much metal can be removed per hour as with a machine using a disc milling cutter of the same pitch. With the improvements in hobs suggested by the author the