number of inches of diameter per tooth, since the circular pitch is the number of inches of circumference per tooth. The diametral pitch is, however, the inverse and is not a number of inches. The following formulas are adopted by Brown and Sharpe:

$p = \frac{\pi d}{t}$; $q = \frac{t}{d}$; $h = \frac{1}{q}$; $h_2 = \frac{1}{q} + \frac{p}{20}$; $w = \frac{p}{2}$

these dimensions being used for cut teeth. For cast teeth $w = .48p$, and hence there is a *back lash* $= .04p$ between any pair of teeth which are in mesh. In cut gears there is no back lash. Notice that since $h_2 = h_1 + \frac{p}{20}$ there is always a *clearance* space of $.05p$ between the top of one tooth and the root line of the other.

It will be evident at once that if a pair of gears are to work together it is necessary that they have the same pitch p, and also that in the cycloidal system the same describing circle must have been used in both, or if in the involute system the same obliquity should be used in both. Wheels so constructed that any pair of them may work together correctly are called *set wheels*. Let d_1 and d_2 be the pitch diameters and r_1 and r_2 the radii of two wheels which are to work together, the shafts being l inches between centres, and the wheels turning at n_1 and n_2 revolutions per minute. Then from page 15

$$r = \frac{n_2}{n + n_2} \cdot l, \text{ and } r_2 = \frac{n}{n + n_2} l$$

this formula applying to spur gears only, not to annular gears. Further $\frac{r}{r_2} = \frac{t}{t} = \frac{n_2}{n}$.

Example:—Two spur wheels are to be placed between shafts running at 100 and 200 revs. per min. respectively, the shafts being 9 in. centres, and the diametral pitch being 3. Then $r_1 = \frac{200}{100 + 200} \times 9 = 6$ in. while $r_2 = \frac{100}{100 + 200} \times 9 = 3$ in. Thus $d_1 = 12$ in., $d_2 = 6$ in. Again, $t_1 = qd_1 = 3 \times 12 = 36$ teeth, and $t_2 = 3 \times 6 = 18$ teeth. The outside diameter of the gears are $d_1 + \frac{2}{q} = 12 + \frac{2}{3} = 12\frac{2}{3}$ and $d_2 + \frac{2}{q} = 6 + \frac{2}{3}$ or $6\frac{2}{3}$ in. The circular pitch p is $\frac{\pi d}{t} = \pi \frac{1}{t} = \pi \frac{1}{d}$, or $p = \frac{\pi}{q} = \frac{3.1416}{3} = 1.047$ in. The height $h_2 = \frac{1}{q} + \frac{p}{20} = \frac{1}{3} + \frac{1.047}{20} = .385$ in. $\therefore h = .719$ in.

The student should practice solving problems on gears, assuming different quantities, and also working on questions in-